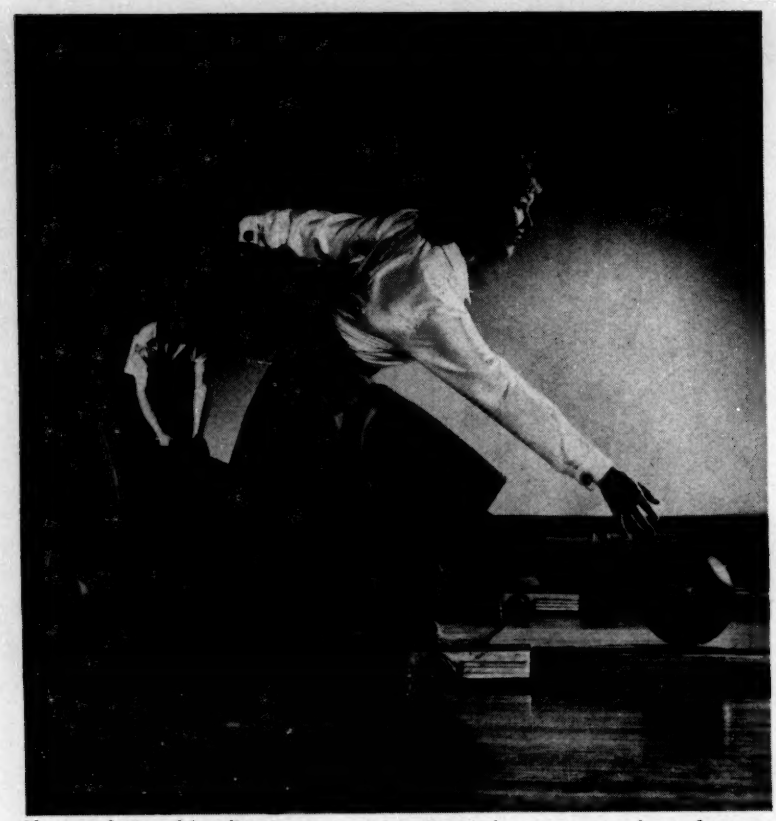
DECEMBER
1960

Industrial Refrigeration

For the men who SPECIFY, BUY and OPERATE Refrigeration and Air Cooling Equipment

COVER—This workman is performing one step in building trucks and trailers to meet AFDOUS Code with new construction methods. See page 22.

In bowling alleys and banks, bakeries and beauty parlors... You'll find



The popularity of bowling has increased so sharply in recent years that today more Americans actively participate in bowling than in any other indoor sport. Air-conditioned alleys have made it possible for bowlers to enjoy the game the year round.

genetron®
SUPER-DRY REFRIGERANTS

Approved! Accepted! Preferred!

In thousands of applications, you'll find "Genetron" refrigerants filling the air-conditioning and refrigeration needs of modern America. "Genetron" refrigerants offer unexcelled purity and dryness . . . and their strict quality specifications are consistently *bettered* in production. Leading equipment manufacturers, refrigeration engineers and air-conditioning and refrigeration wholesalers approve, specify and recommend them. They know they can always count on "Genetrons" for dependable, trouble-free service.

"Genetron" Super-Dry Refrigerants are available from wholesalers everywhere, coast to coast. See your wholesaler. Insist on "Genetron"!

genetron 11 ORANGE LABEL CCl_3F
TRICHLOROMONOFLUOROMETHANE

genetron 12 WHITE LABEL CCl_2F_2
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genetron 22 GREEN LABEL $CHClF_2$
MONOCHLORODIFLUOROMETHANE

genetron 113 PURPLE LABEL $C_2Cl_3F_3$
TRICHLOROTRIFLUOROETHANE

genetron 114 BLUE LABEL $C_2Cl_2F_4$
DICHLOROTETRAFLUOROETHANE

Air-conditioning is a "must" inside bank vaults, museum and library storage rooms and other areas where, for security reasons, there are no windows or little air circulation. Precise control of temperature and humidity also protects important records against atmospheric variations.

Modern baking is a highly mechanized operation—far removed from grandma's oven. In this photo, crackers pour from the delivery end of an automated travelling oven. Air-conditioning is used in large commercial bakeries today to control temperature and humidity and for employee comfort.

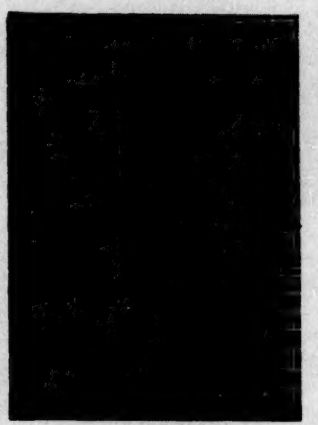
It gets pretty hot under a hair dryer—even *with* air-conditioning. And the girls like to enjoy having their hair done. That's why so many beauty parlors are so well air-conditioned. It benefits customers . . . employees . . . *and* owners!

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N.Y.

Allied Chemical

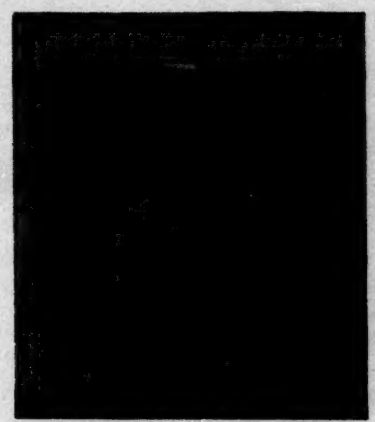
THE INDUSTRY'S FINEST...

ALL TYPES



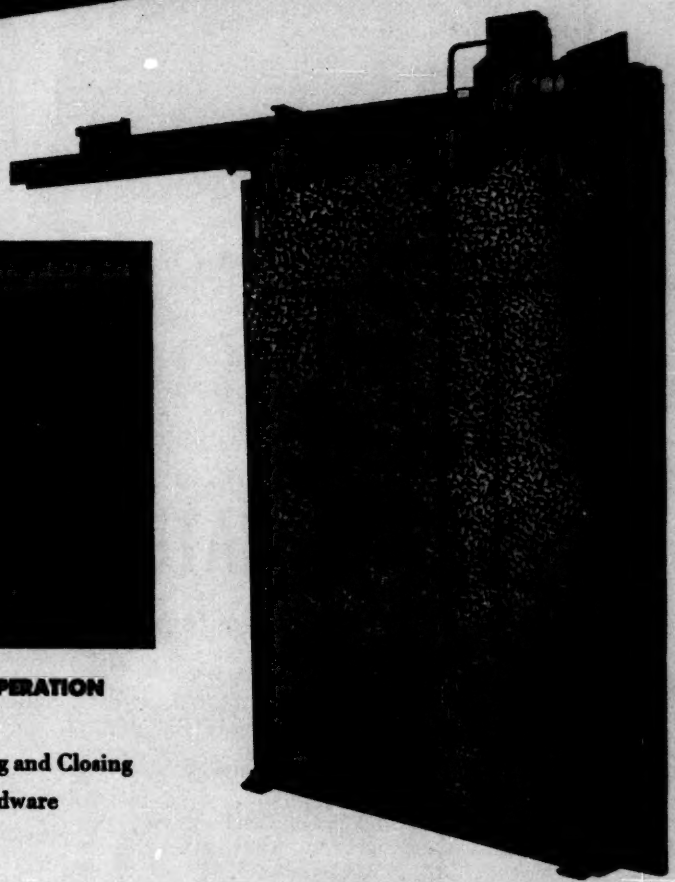
AIR OPERATION

- Safety Entrance and Exit Through Built-In Refrigerator Door
- Speedy Opening and Closing



MANUAL OPERATION

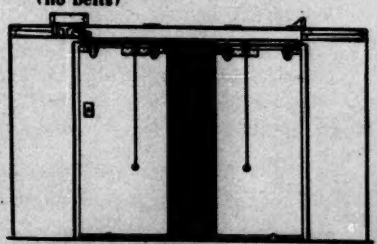
- Dependable
- Easy Opening and Closing
- Durable Hardware



Write for descriptive bulletin . . .

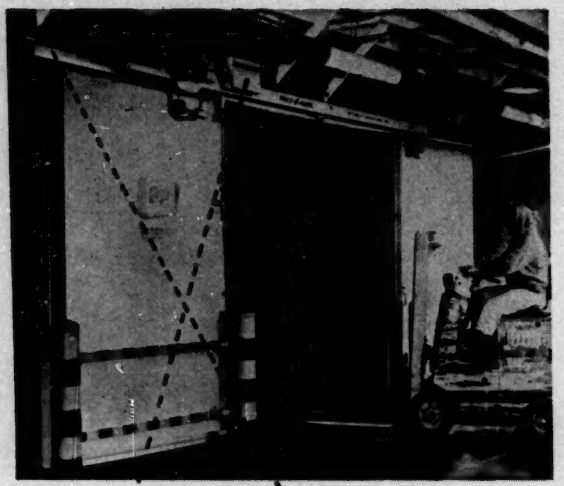
"Electro" SAFETY SLIDE

- Structural Simplicity
- Mechanically Sound
- Exclusive Automatic Sealing
- Gear Type Uni-Brake Motor Operation (no belts)



BI-PARTING "ELECTRO" SAFETY SLIDE DOORS

- Recommended where space factors dictate their use
- Gear Type Uni-Brake Motor Operation (no belts)



No cams to wear . . . No complicated parts to repair

One Reason Why

PREST-O-MATIC®

Outperforms and Outlasts other Cold Storage Doors

PREST-O-MATICs operate flawlessly on a minimum of moving parts. No cams, no springs, no eccentrics to go out of whack, causing stoppages, leakage and spoilage — not to mention traffic slowdowns and missed schedules. That's why so many manufacturers, warehouses and food chains insist on PREST-O-MATIC Freezer and Cooler Doors.

Exclusive inclined and tapered dual-glide tracks float the door to a quiet stop — give you wedge-tight sealing all around. Full length safety edge; easy-to-work manual release; durable new pull cord switches. You choose the motive power — Air or Electric.

Optional on all PREST-O-MATICS is our new POM (Partial Opening Man) Control. This unique feature permits doors to open only 32 inches for pedestrian traffic. Saves time and refrigeration.

Write for full information or see our insert in Sweet's Catalog.

CLARK DOOR COMPANY, INC (since 1878)

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King

Air Defrost Increases Efficiency of Low Temperature Blast Freezing

The King Company's many years of experience have provided them with operating data on the various defrosting methods. King Co. engineers have found air defrost most advantageous. Some of the more important benefits are:

1. Freezing units are usually located outside of the cold room, saving valuable space, making service easy and comfortable.
2. Units may be defrosted in 20 to 30 minutes, once every two days to once every two weeks.
3. Defrosting operation requires minimum maintenance . . . no expensive defrosting agents are used . . . longer life for equipment is assured.
4. Full freezing capacity up to defrost time; longer periods between defrosting are results of higher capacity heat transfer engineered into King time-tested "wide-spaced" coil fins.

King engineers are always ready to advise operators of freezing or storage plants of the best procedure for any particular problem. This service is provided at no extra cost to users of King Sharp Freeze Systems.

50 years of experience is at your service

King COMPANY OF OWATONNA

907 Cedar St. OWATONNA, MINNESOTA

Industrial Refrigeration

December 1960

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A NATIONAL MAGAZINE FOR:

- **Plant Engineers and Operating Personnel**
- **Application Engineers and Contractors**

WHERE REFRIGERATION EQUIPMENT IS USED FOR:

- **Food Freezing, Storage and Transport**
- **Processing and Cooling Applications**
- **Research and Development**

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69 Years of Continuous Publication

New Products Designed to Improve Operation

Liquid Level Controller

THE Sonoswitch just introduced by Powertron Ultrasonics Corporation now affords a completely safe means of controlling all liquids including corrosive or explosive fluids. The explosion proof stainless steel probe instant-

ly actuates when any liquid touches its sensitive probe surface. The unit has a repeatability within thousandths of an inch and is not affected by film or scale build up. The Sonoswitch does not actuate in foam or froth. The new ultrasonic probe is capable of operating at pressures over 2000 psi.

The probe has no moving parts to be fouled; it requires no maintenance once installed.

The new switch is used for overfill alarms, automatic pump start-up and shut-down, low level indications, and a variety of centralized solenoid valve programming.

The ultrasonic probes along with their respective controllers are offered in a variety of forms. Controllers may be obtained with indicating lights or aural annunciators.

Insulating Tape

THE polyurethane foam insulating tape produced by Arno Adhesive Tapes, Inc., has been improved to give greater protection against heat, cold, shock, vibration, dust, sound, moisture and electricity.

Called "Arnofoam," the tape is available in three thicknesses of urethane foam backing, ⅛", ¼" and ½". The backing is firmly bonded to a strong, moisture-resistant transparent backing film. It has a high-tack transparent pressure-sensitive adhesive.

The tape has an adhesion to steel of 75 ounces per inch width and a compression strength of 1½ pounds per square inch. It has a continuous high temperature limit of 260 degrees Fahrenheit and an intermittent limit of 300 degrees. (The foam also displays excellent low-temperature properties.)

The tape is used for weatherstripping, dust and moistureproofing, soundproofing and as packaging protection against shock, heat and cold.

Packaged Liquid Chillers

A NEW line of hermetic packaged liquid chillers for industrial cooling applications is now available from American-Standard Industrial Division. The new chillers designated the Versare line, are available in eleven models for net

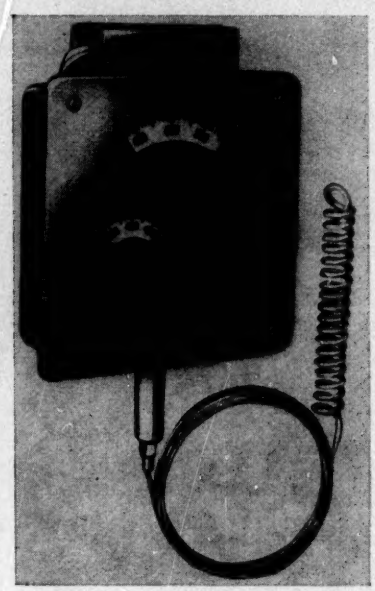
rated capacities up to 67.1 tons, depending upon condenser water temperature conditions and desired leaving chilled water temperature. The standard design Versare units are also available without condenser and with accessories for use on remote condenser applications. Small capacity increments from model to model give the new line unique versatility to meet the requirements of every installation.

The package design is complete, requiring only a minimum of water piping and electrical connections to be made in the field. Unusual compactness in the new units has been aimed at slimness sufficient to permit passage through a 36-inch doorway; every complete unit meets this requirement.

Hermetic compressor construction eliminates problems associated with field alignment of compressor and electric motor drive. With no shaft seal, maintenance problems and refrigerant leakage are greatly reduced.

Indicating Temperature Control

THE dual switch indicating temperature control is one of the latest controls to be added to the United Electric line of industrial temperature and pressure controls.



It is a versatile wide range temperature control (-150 to +650° F.) ideally suited for such applications as ovens, baths, environmental test chambers, molding machines, plant processes, etc. It features a calibrating mechanism which makes possible easy replacement of the thermal assembly in the field with no loss of calibration accuracy.

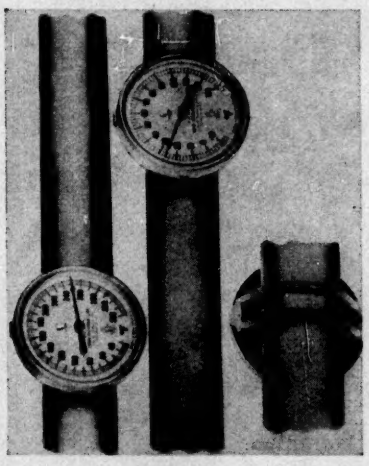
The control contains two separate switches permitting switch action above or below the index set point and control of up to four

independent circuits. The index scale is calibrated in the same easily-read values as the indicating scale to eliminate visual errors.

The thermal system consists of a bulb, capillary and bellows filled with temperature sensitive liquid. The bellows expand or contract with heating or cooling, thus actuating the snap-action switches at the present temperature points.

Pipe Thermometer

THE Abrax Instrument Corporation, New York, announces a new pipe thermometer that clips to steam, water, refrigeration, gas and other pipes by means of twin spiral spring clips supplied with



each instrument. The instruments can be attached or removed from the pipes in seconds and require no alteration of the pipes. This factor eliminates any need for branching or drilling. The thermometers are precalibrated to counteract the possibility of error through heat losses of radiation or convection.

They can be used for all pipes up to 3½" in diameter. The dials are 2½" in diameter, silvered, with black figures and polished chrome casings. The thermometers are graduated 2° divisions.

The thermometers come in two temperature ranges; plus 32° to 320°F. and minus 14° to plus 134°F.

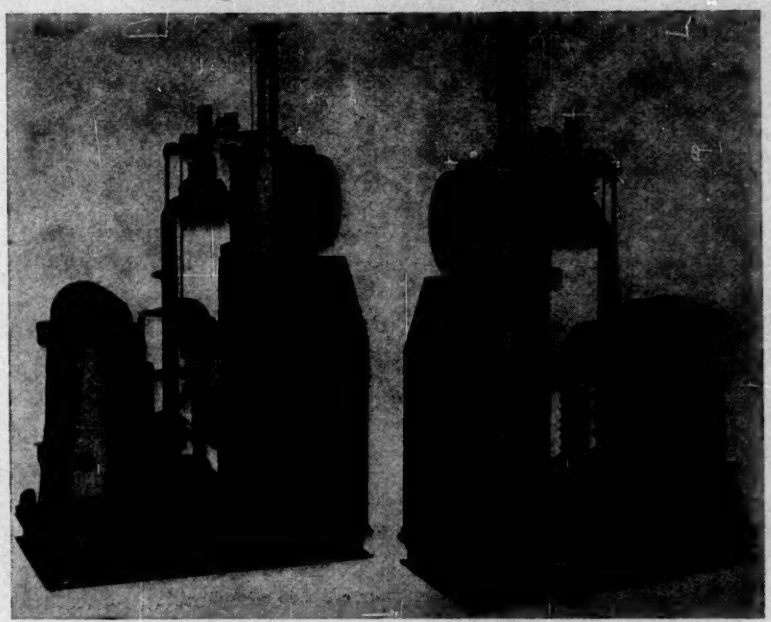
Air Wash Treatment

DEARBORN Air Wash Treatment 1, a surface active compound that improves the operating efficiency of air wash systems in textile mills and tobacco plants, has been developed by Dearborn Chemical Co.

Air Wash 1 is designed to remove sticky deposits which already are in place in operating air wash systems and to prevent the formation of new deposits in clean systems. These characteristics improve the efficiency of operating equipment and reduce downtime and maintenance costs.

Soluble in water, the compound is compatible with standard corrosion and scale inhibitors and biocides normally present in chilled recirculating cooling water. It is almost water white and has a mild, spirit-like odor. It is ready for immediate use and is easily fed to the chilled water by slowly pouring the required amount to a point of rapid circulation. The product is available in 55-gallon steel drums or 5-gallon steel pails.

"Packaged" Vacuum Pumping Systems



ORIGINAL equipment designers should welcome with enthusiasm the concrete assistance in solving their problems of high-volume evacuation that is provided by the new series of "packaged" vacuum pumping systems which has just been announced by F. J. Stokes Corporation, Philadelphia.

The systems are composed of an oil-diffusion pump or an oil-booster pump, plus a mechanical backing pump, mounted together on a common base-plate, along with a fully-instrumented control console and all interconnecting piping, valves, and wiring. They arrive completely assembled, ready for connecting to the customer's water, air, and electricity supply lines.

Heart of the 10-inch "packaged" system is a Stokes 10-inch oil-diffusion pump, backed by a Model 149-H "Microvac" rotary mechanical pump. An air-operated right-angle poppet valve and a roughing by-pass connection with a separate gate valve are also supplied as part of the engineered "package." The system also incorporates a 2-cfm. compound pump for holding the hot diffusion pump during the roughing cycle.

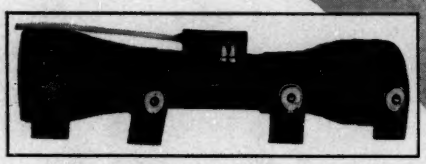
The new Stokes "packaged" vacuum pumping systems represent a significant step forward in component design, in that all of the engineering problems within the pumping system have been completely taken care of for the designer in advance. The control console, which is completely wired to J.I.C. standards, mounts a Stokes thermocouple gage and a Stokes discharge-type ionization gage, as well as the control transformer for the gaging current. It provides push-button controls for the several valves and pumps which have been properly interlocked by pre-wiring so that they will automatically be operated in the correct sequence. It also has convenient controls for the pump-cooling water and the air-supply to the pneumatically operated valves.

Safety devices built into the systems include fail-safe controls for automatic shutdown in the event of power failure, Underwriters' Laboratory-approved wiring and belt guards.

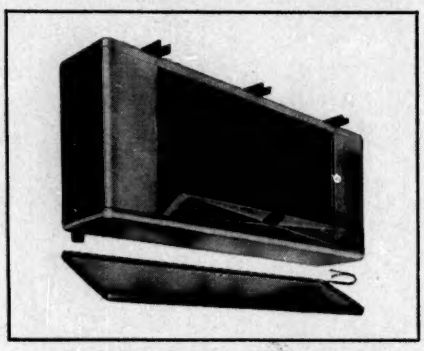
Versatile...

Safeway molded heaters—available in almost any plane or contoured shape.

Safeway "strong" construction for special designs.



Custom-made for Rocketdyne Redstone engine propulsion system, flexible tube heaters provide uniformly dependable heat to all surfaces of the components.



Dunham-Bush refrigeration system, showing Safeway heating blanket fitted to drip pan—prevents re-freezing of water during defrosting.

Electrical thermal de-icing boots on aluminum alloy blades of Curtiss-Wright Electric propellers. Also used on extruded hollow steel blades on Electric and Turbolectric propellers.

SAFEWAY Heat Elements solve cold problems everywhere!

From economically solving a defrosting problem in industrial refrigeration to dependably protecting aircraft and engines in icy aero-space—that's some idea of the performance range of Safeway Heating Blankets and Elements.

For these and scores of in-between applications, Safeway products assure thoroughly reliable *controlled heat*, regardless of environmental temperature.

If you have a "cold-control" problem, put Safeway's modern manufacturing facilities to work for you—devoted exclusively to the design, engineering and manufacturing of heating, de-icing and de-frosting units, such as:

- heating elements for launching equipment and for airborne gyros, cameras, computers, servos and batteries—for missiles or aircraft
- de-icing units for airfoil surfaces
- heating elements for all types of ground support equipment
- defrosting units for industrial and commercial refrigeration
- heating blankets for honeycomb and metal-to-metal bonding

For your copy of a fact-filled folder, please write:

If it has to be heated (and the "it" can be just about anything), you can rely on SAFEWAY engineers to study your problems carefully, and—without any obligation—submit an appropriate recommendation.

Safeway HEAT ELEMENTS INC.

Middlefield Street • Middletown, Connecticut

news briefs of the month

Ice Takes and Creates Employment

Ice making was big business in the state of Maine near the turn of the century when river ice was shipped by schooners to South America and other foreign countries. Then someone invented a machine to make ice and the big business came to an end. Its a machine that is responsible for jobs for Maine workers in the ice industry again. A Maine concern has received a million-dollar contract to manufacture a coin operated machine that will make and sell ice. Said to be the first of its kind, the machine makes and stores its own ice cubes, eliminating the necessity of an attendant to replenish the supply. It will be used at gasoline service stations, supermarkets and other public places.

Jamison Gets Sales Right To Air Curtain

The Jamison Cold Storage Door Company of Hagerstown, Md., has been named by the Lehigh Manufacturing Company, a division of Lehigh Incorporated, of Easton, Pennsylvania, to handle the sales, distribution and service of the newly developed "air isolator" manufactured by Lehigh. Jamison will distribute the apparatus to users in the refrigeration industry and also other fields where temperature control is not a determining factor. The new apparatus provides an air barrier for warehouses, loading docks, controlled-humidity rooms, and areas with odor, dust and vapor problems. One application was described in the January issue, INDUSTRIAL REFRIGERATION, page 28.

Faster Thawing For Frozen Fish

Industrial thawing of frozen fish now takes 15 minutes, instead of the usual 24 hours, by a new process developed in Scotland called dialectric heating. Principle of the new method is that the heat generated by two metal plates, each charged with an alternating voltage of many thousands of volts at a frequency of about 40 million cycles per second, is sufficient to thaw any frozen material placed between them (but not touching). An advantage of dialectric thawing as applied to fish is that it is even throughout, and does not start with the outer surface. Capital cost for equipment able to thaw fish at the rate of 2,240 lbs. per hour, is $28,000 in Britain. The fish is fed into a machine on an endless belt, requiring no handling.

World Adopts New Standard of Length

At 6:00 p.m. Paris time October 14, the world adopted a new international standard of length—a wavelength of light—replacing the meter bar which has served as the standard for over seventy years. The announcement was made from Paris by Dr. Allen V. Astin, Director of the National Bureau of Standards, U.S. Department of Commerce. The action was taken by the 11th General Conference on Weights and Measures, which met in Paris in October.

Transitron to Acquire Thermo King Corp.

Transitron Electronic Corp. in Wakefield, Mass., and the Thermo King Corp. Minneapolis, have entered an agreement under which Transitron will acquire the assets of Thermo King, manufacturers of refrigeration equipment for truck-trailers, according to recent reports. The plan requires approval by holders of 2/3 of the outstanding stock of Thermo King but the approval of Transitron stockholders is not required.

TRRF Makes Grant For Low Temperature Research

A research project involving temperatures as low as 450 degrees below zero Fahrenheit was revealed recently by The Refrigeration Research Foundation of Colorado Springs. Colorado College will conduct the work to see how biological and other materials behave at these very low temperatures. Announcement of an initial grant of $4500 for the project was made by Millard W. Young of San Francisco, president of The Refrigeration Research Foundation. He said the fund would go primarily to purchase the highly specialized equipment needed in the research.

Good Practice In

The application engineer is normally responsible for the proper sizing of refrigerant lines in refrigerating systems. He lays out the piping to conform to the best available information. The operating engineer, however, is the man who will have to "live" with the installation. For this reason the operating engineer should try to spot trouble areas on the blue prints before they become "headaches". This article is intended to provide some help.

By ELLIOTT R. WHITMAN

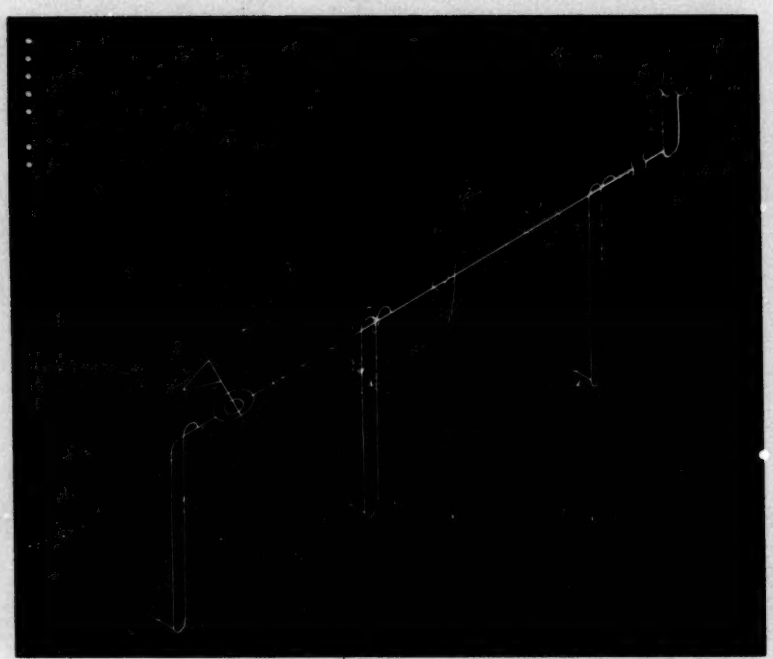


FIG. 1

Table 1 — Temperature-Pressure Conditions, Various Refrigerants Condensing at 105°F, 40°F Suction

CONDITION	HEAD				SUCTION			
	Comp. Temp. Rating	Pressure Rating Gage R-12	R-22	R-500	Com. Temp. Rating	Pressure Rating Gage R-12	R-22	R-500
Saturated Condition at Compressor Discharge	107°F	130.4	219.7	157.8				
Loss in Hot Gas Line	−2°F	3.8	6.7	4.6				
Design Condition	105°F	126.6	213.0	153.2	40°F	37.0	69	46.2
Pressure Loss in Liquid Piping	−2°F	3.9	6.1	4.6				
Pressure of Liquid at Evaporator	103°F	122.7	206.9	148.6				
Pressure Loss in Suction Line					+2°F	1.8	3	2.2
Actual Pressure at Evaporator					42°F	38.8	72	48.4

»» SIZING of refrigeration lines is not difficult if the problems involved are understood. Three problems must be resolved. These are creating a pressure gradient or differential between the source and the point of delivery, sizing of the piping system sufficiently large so that the pressure drop caused by frictional resistance is not unduly large, and insuring that oil returns to the compressor.

An economic factor is also involved. It is well enough to increase the size of pipe conveying the liquid or gas one or two pipe diameters to cut down on the frictional resistance. But is the overall increased cost of the piping system and its insulation worth the increased efficiency that is obtained by reduction in frictional resistance? Care should be used in making a determination of the sizing method.

Most designers of refrigeration piping systems tend to standardize their design unless there is something unusual about a specific application.

The author generally uses a 2°F criterion as the pressure loss that he is willing to tolerate in each of the lines. This is to say that the suction, liquid, and hot gas lines are computed for an individual loss of 2°F in each phase of the refrigerant circuit. Some authorities recommend other values. One other criterion that is frequently used is a loss of 1° in the suction line and 3°F in the liquid line. This is also an excellent criterion. The author often uses it when making adjustments to obtain standard pipe sizes. That is, liquid lines are made smaller than the 2°F actually indicates, whereas suction lines are made larger. One exception is generally made by all designers on hot gas lines for factory assembled condensing units where the length of run is unusually short. A compromise is usually reached that will result in a very small loss but with the pipe sized large enough to prevent whistling of the gas. This compromise is generally based on previous experience or trial and error. Whenever doubt

Sizing Refrigerant Lines

exists on extremely short-coupled systems, it is generally preferable to go to the next larger size piping as the overall cost for a small unit is negligible.

It is realized that some may not understand what is meant by a 2°F pressure loss as pressure is not measured in degrees Fahrenheit. This terminology is used to correlate the pressure loss with the operating conditions of the compressor which are based on temperature rating. The 2°F loss refers to the equivalent saturated pressure loss in a line at its design condition. The actual pressure loss in the various lines are relative figures and subject to slight changes dependent upon a number of factors.

Standard Conditions

Using a standard condition of 105°F condensing 40°F suction that is frequently specified and a 2°F loss in each of the lines we would have the values shown in Table I for various common refrigerants.

It should be noted that the pressure on the suction side of the evaporator is 2°F higher than that at the inlet to the compressor. This obtains the necessary pressure gradient to move the gas from the evaporator to the compressor. If the pressures are identical, flow would not take place.

We have discussed the problems of providing the proper pressure differential and sizing of piping to prevent an excessive drop. It is true that these have been discussed rather briefly and an arbitrary rule of thumb method has been indicated, but an exact theoretical and mathematical analysis of the entire problem would require considerably more space than allotted or this article would warrant. The criterion previously established and the methods to be outlined later in this article are sufficient for most technical applications and if used correctly offers less probability of mathematical error than would a more precise approach. Similar methods have been used by some of the larger manufacturers in their advanced training program for dealers and factory personnel. Consequently, the procedure is time tested.

All reciprocating compressors pump oil to some degree. Some of this oil is that which leaks between the cylinder walls and the piston. The fit of the rings is one of the determining factors on the amount of oil that leaks through in this manner. Oil leakage by blowing past the rings of well designed and maintained compressors is small. The miscibility of the oil and the refrigerant is another reason why oil gets into the compressor discharge line. The oil in the compressor crankcase having an affinity for the fluorinated refrigerant readily absorbs any refrigerant that leaks into the low pressure side of the system. As oil temperature is increased by frictional resistance on start-up, the absorbed refrigerant is given off rapidly, causing frothing and foaming of the oil. This oil in the form of foam overflows from the crankcase, through the valves, and into the compressor discharge.

This oil frothing can cause compressor failure by forming a solid mass against the head of the cylinder or by loss of the entire oil charge and subsequent failure because of lack of lubrication. The latter is usually the case.

However, once the oil has gotten past the compressor discharge, it must be returned to the compressor crankcase in some manner. One of the solutions to prevent this is to use an oil separator. Another is to repair an oil pumping compressor. However, the oil separator presents other problems. They in themselves, like all mechanical devices, are never one hundred percent efficient. Consequently, the piping must be specifically designed to return oil to the compressor whether or not a separator is installed.

The return of oil is one of the most important aspects of piping design. However, it is not a problem in liquid lines. It exists in hot gas and suction lines only. This is because the oil is readily soluble in the refrigerant but drops out as soon as the refrigerant flashes into a gas.

This includes the proper sloping of the lines to return the oil by slow gravity flow and by the utilization of high velocities to entrain the oil or carry it along the periphery of the pipe as a ripple. The velocity in the horizontal line should be a minimum of 750 feet per minute and the vertical line velocity should be 1500 feet per minute. The higher velocity is required in the vertical line as it must lift the weight of the oil whereas in the sloping horizontal line the velocity is merely used to push the oil along.

Slope Lines

Lines should be sloped a minimum of ½ inch in 10 feet. To prevent traps caused by sagging, adequate supports should be provided. The spacing of these is dependent upon the pipe diameter. The recommended spacing of supports are for ⅝" every 6 feet, for ⅞"–1⅛" every 8 feet, and for 1⅜" and larger every 10 feet.

It should be noted that the terminology *minimum* velocity was used. This indicates the velocity occurring at the minimum step reduction of the compressor. If more than one evaporator is located on a line and the compressor has unloading device, the analysis of minimum velocity becomes tricky. For example, suppose we have a situation of three evaporators located as shown in Fig. 1. There are a number of possible detrimental conditions in these applications.

Suppose the compressor has reduced to its lowest capacity step and all evaporators are operative. Again assume that all are loaded in exactly the same ratio as they were designed. Hence, evaporator number one load has been reduced to ¼ of its design load or 1¼ tons, evaporator number two to 2½ tons, and evaporator number three to 3¾ tons. The minimum velocity for the vertical riser on evaporator number one is now 1500 feet per minute at 1¼ tons. However, there is another complicating factor. Suppose that

Table 2 — Line Sizes, Normal Condensing Pressure — Refrigerant 12

Evaporator Load, Tons	Suction Condition														
	−40			−20			0			20			40		
	S	L	HG	S	L	HG	S	L	HG	S	L	HG	S	L	HG
1/2	1-1/8	1/4	1/2	7/8	1/4	1/2	3/4	1/4	1/2	3/4	1/4	1/2	3/4	1/4	1/2
1	1-3/8	3/8	5/8	1-1/8	3/8	5/8	1-1/8	3/8	5/8	7/8	3/8	5/8	3/4	3/8	1/2
2	1-5/8	1/2	3/4	1-5/8	1/2	3/4	1-3/8	1/2	3/4	1-1/8	1/2	3/4	1-1/8	1/2	3/4
3	2-1/8	1/2	7/8	1-5/8	1/2	7/8	1-5/8	1/2	7/8	1-3/8	1/2	7/8	1-1/8	1/2	7/8
5	2-5/8	5/8	1-1/8	2-1/8	5/8	1-1/8	1-5/8	5/8	1-1/8	1-5/8	5/8	1-1/8	1-3/8	5/8	1-1/8
7-1/2	3-1/8	5/8	1-3/8	2-5/8	5/8	1-3/8	2-1/8	5/8	1-3/8	1-5/8	5/8	1-1/8	1-5/8	5/8	1-1/8
10	3-1/8	3/4	1-3/8	2-5/8	3/4	1-3/8	2-5/8	3/4	1-3/8	2-1/8	3/4	1-3/8	1-5/8	3/4	1-3/8
Refrigerant 22															
1/2	7/8	1/4	1/2	3/4	1/4	1/2	5/8	1/4	1/2	5/8	1/4	1/2	1/2	1/4	1/2
1	1-1/8	3/8	1/2	1-1/8	3/8	1/2	7/8	3/8	1/2	3/4	3/8	1/2	5/8	3/8	1/2
2	1-3/8	1/2	5/8	1-1/8	1/2	5/8	1-1/8	1/2	5/8	7/8	1/2	5/8	3/4	1/2	5/8
3	1-5/8	1/2	3/4	1-3/8	1/2	3/4	1-3/8	1/2	3/4	1-1/8	1/2	5/8	7/8	1/2	5/8
5	2-1/8	1/2	3/4	1-5/8	1/2	3/4	1-3/8	1/2	3/4	1-3/8	1/2	3/4	1-1/8	1/2	3/4
7-1/2	2-5/8	5/8	1-1/8	2-1/8	5/8	7/8	1-5/8	5/8	7/8	1-3/8	5/8	7/8	1-3/8	5/8	7/8
10	2-5/8	5/8	1-1/8	2-1/8	5/8	1-1/8	2-1/8	5/8	1-1/8	5/8	5/8	1-1/8	1-3/8	5/8	1-1/8

The above tables are for 50' or less of tubing with normal fittings using non-unloading type compressors.

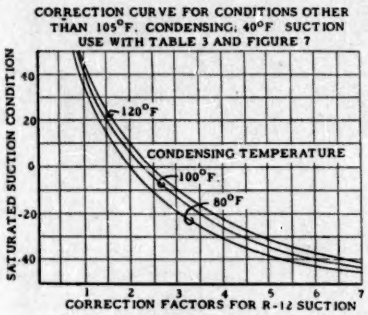


FIG. 2.

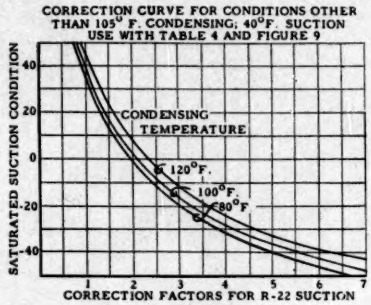


FIG. 3.

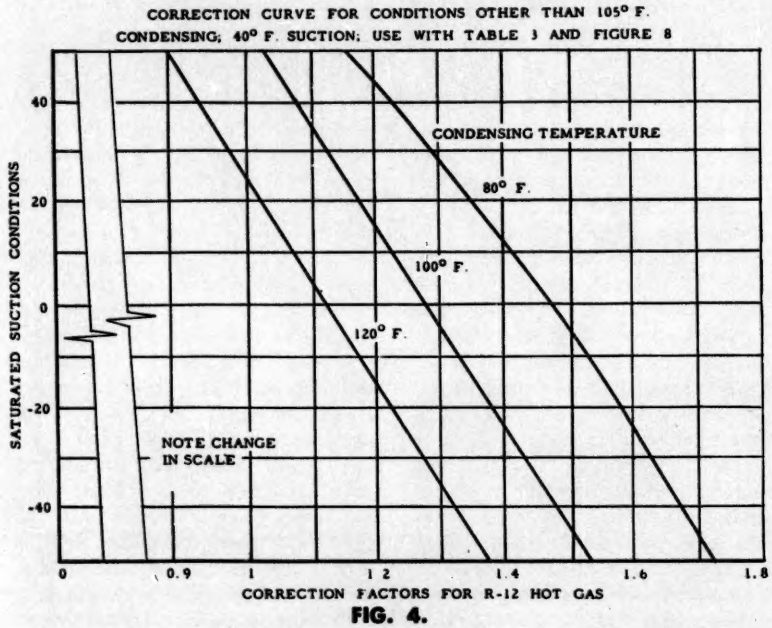


FIG. 4.

evaporators two and three are satisfied as far as liquid refrigerant is concerned and their solenoid valves are closed. Then we would have a 30 hp compressor operating at ¼ capacity or 7½ tons serving a five ton coil.

Under evaporator full-load conditions the compressor is oversized for the coil and the evaporator temperature will reduce to below normal when the system balances out. At partial load conditions the coil will probably freeze. To prevent icing condition, a back pressure regulating valve must be placed in the suction line of this evaporator. As the velocity of refrigerant gas is directly proportional to the refrigerant flow, this could further complicate the oil return as the purpose of the regulating valve is to retard the flow of refrigerant.

In this particular instance the back pressure regulating valve would have little effect as far as the velocity of refrigerant is concerned. However, the effect of such reduction in velocity should be thoroughly investigated every time a back pressure regulating valve is installed in a line. Many compressors have repeatedly failed because the effect of back pressure regulating valves on capacity reduction and resultant oil return were not considered.

Table 3 — Pipe Sizing Data, Refrigerant 12

Equivalent Length of Pipe	Type of Line	OD Line Sizes, Type L Copper Tubing											
		1/2	5/8	3/4	7/8	1-1/8	1-3/8	1-5/8	2-1/8	2-5/8	3-1/8	3-5/8	4-1/8
25	Liquid	7	12	22	34	70	120						
	Suction	0.6	1.2	2.1	3.2	6.5	12	18	38	70	110		
	Hot Gas	1.7	3.1	6	8	16	29	46	98	160			
50	Liquid	4.7	8	15	23	48	82	130					
	Suction		0.8	1.4	2.1	4.5	8	12.5	26	46	75	115	
	Hot Gas	1:1	2.1	3.6	6	12	20	32	65	120			
75	Liquid	3.7	7	12	18	38	70	105					
	Suction		0.7	1.2	1.7	3.6	7	10	21	37	60	88	128
	Hot Gas	0.9	1.7	2.8	4.5	8.5	16	26	55	90	155		
100	Liquid	3.2	6	10	16	32	57	90	185				
	Suction		0.6	0.9	1.5	3.1	5.5	8.5	18	32	52	76	110
	Hot Gas	0.8	1.4	2.5	3.8	8	13	22	45	80	130		
150	Liquid	2.6	4.9	8	13	26	45	70	150				
	Suction			0.8	1.2	2.4	4.2	7	13	26	41	60	88
	Hot Gas	0.7	1.2	2	3.1	6.5	11.5	18	37	65	105		
200	Liquid	2.2	4.2	7	11	22	38	60	130				
	Suction			0.7	1.1	2.1	3.6	6	12	21	35	52	75
	Hot Gas	0.6	1.0	1.7	2.6	5.5	9	15	3.1	55	90	130	

Table 4 —Pipe Sizing Data, Refrigerant 22

Equivalent Length of Pipe	Type of Line	OD Line Sizes, Type L Copper Tubing											
		1/2	5/8	3/4	7/8	1-1/8	1-3/8	1-5/8	2-1/8	2-5/8	3-1/8	3-5/8	4-1/8
25	Liquid	11.8	21	36	60	120							
	Suction	1.2	2.2	3.6	6	12	21	34	70	128			
	Hot Gas	3.1	6	9	16	31	58	85	185				
50	Liquid	8	14	25	38	80	135						
	Suction	0.8	1.6	27	4.1	8.2	14	23	48	85	140		
	Hot Gas	2.1	4	7	11	21	37	60	120				
75	Liquid	6.8	12	20	31	60	110						
	Suction	0.7	1.7	2.1	3.2	7	12	18	38	70	110		
	Hot Gas	1.6	3.1	5.1	8.1	16	30	47	90	170			
100	Liquid	5.6	10	17	26	56	92	150					
	Suction	0.6	1.1	1.7	2.7	6	10	16	33	60	95	140	
	Hot Gas	1.4	2.6	4.5	7	14	25	40	82	150			
150	Liquid	4.3	8	13	21	43	75	120					
	Suction		0.8	1.4	2.2	4.5	8	12.5	26	46	75	110	
	Hot Gas	1.2	2.1	3.6	5.8	11.8	20	32	68	120			
200	Liquid	3.6	7	12	18	37	65	105					
	Suction		0.7	1.2	1.8	3.8	7	11	23	40	68	95	133
	Hot Gas	1	1.7	3.2	4.7	10	17	27	58	100			

Sizing of lines on small systems with a single evaporator and single capacity or non-unloading compressors is usually determined using tables or curves. These methods give excellent results as they have been thoroughly tested. Table 2 presents data for sizing lines on small systems. If a manufacturer recommends values for a specific piece of equipment different from those shown in this table, his recommendations should be followed. In all probability there is some good reason why he selected the sizes he used.

Tables 3 and 4 present data for sizing all refrigerant lines for small systems. Figs. 2 and 3 present a series of curves to be utilized to resize suction piping when saturated suction or head conditions vary from 105°F condensing and 40°F suction. Figs. 4 and 5 present similar data for hot gas lines. Variations in head and suction pressures have little effect on liquid line sizes. Fig. 6 represents a curve that may be used to obtain a multiplier that will give a correction factor if other than 2°F losses in any line is desired.

Figs. 7 through 10 are curves that are to be utilized to ascertain if the velocity in gaseous vertical risers is sufficiently high. If other

Table 5 — Equivalent Length of Pipe for Valves & Fittings*

Line Size	Globe Valve Full Open	Angle Valve Full Open	Tee Side Outlet	Elbow Std Pattern	Swing Check
5/8	16	9	4	2	3
7/8	22	12	5	2	4
1-1/8	28	15	6	3	5
1-3/8	36	18	8	4	6
1-5/8	42	21	9	4	8
2-1/8	57	28	12	5	12
2-5/8	69	34	14	7	14
3-1/8	83	42	17	8	17
3-5/8	99	49	20	10	18

* Based on Crane Co. Data.

Table 6 — Area of Tubing

Size	Area Sq. In. Type K	Area Sq. In. Type L
1/2	0.127	0.145
5/8	0.218	0.233
3/4	0.334	0.348
7/8	0.436	0.484
1-1/8	0.778	0.825
1-3/8	1.217	1.257
1-5/8	1.723	1.779
2-1/8	3.014	3.095
2-5/8	4.657	4.772
3-1/8	6.637	6.812
3-5/8	8.999	9.213

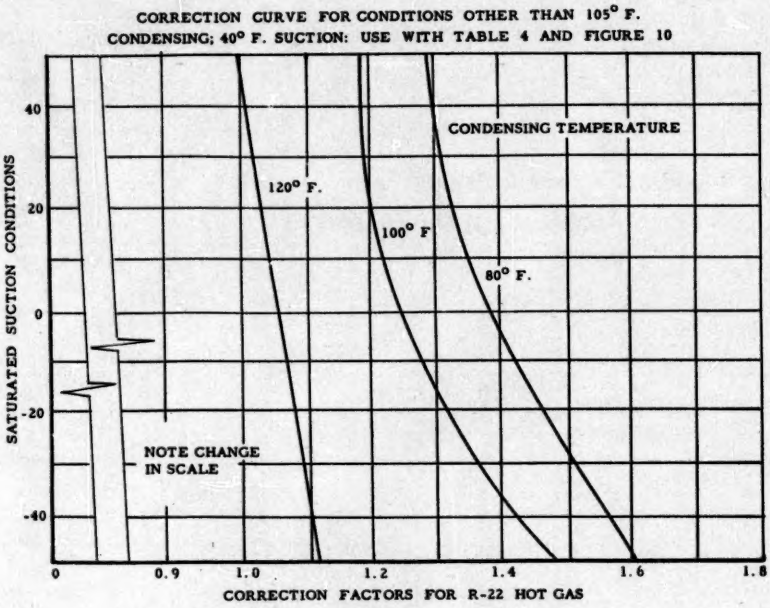


FIG. 5.

condensing and suction pressures are employed, the applicable correction curve, Figs. 2 through 5, should be employed.

Tables 3 and 4 are based on the equivalent length of pipe in a system. The equivalent length is the actual length plus the frictional resistance caused by valves, fittings, etc. These values have been accurately determined by laboratory tests. Table 5 presents such data.

Table 6 is a tabulation of tubing areas.

The best method to learn how to size refrigerant piping is to work through an example. Refer back to Fig. 1 showing the three evaporators on a single compressor. This is a refrigeration load operating at 105°F condensing and 40°F suction.

In multiple evaporator set-up, the refrigerant lines are sized beginning at the last coil assuming that the other coils do not exist. Under this condition we will have an actual length of:

1 ft. Horizontal run.
8 ft. Vertical rise.
80 ft. Horizontal run to vertical lift.
12 ft. Vertical rise.
30 ft. Piping inside machinery room.
131 ft. Actual length of piping.

Assuming approximately 50 percent for fittings, we will have an approximate equivalent length of 65 ft. plus 131 ft. or say 196 ft.

If the refrigerant to be used is R-22, refer to Table 4, we see that 196 ft. of equivalent length is not listed. However, 200 ft. is the nearest listed tabulation. It appears as though a 1⅜ inch tube will be satisfactory to carry the 5 ton load as it will carry 7 tons for 200 equivalent feet.

It will now be necessary to compute the actual equivalent length. It could not be done before as the suction size was not known.

In the line the following equivalent lengths will add resistance to the system.

1—1⅜" gate type valve		0
7—1⅜" elbows	@4	28
1—1⅜" back pressure regulator	@36	36
Total equivalent length		64

The total equivalent length of pipe is 131 plus 64 or 195 ft. This closely approaches the 200 ft. upon which the 1⅜" piping was selected. In the case of a single evaporator, the 1⅜" suction line would be run directly to the compressor. In this instance, it is run only to the junction of the vertical riser from evaporator number two where additional load is placed on the system.

However, the system needs to be checked to ascertain if the velocity in a single 1⅜" line will be ample to return oil at the minimum load condition. Assuming that the minimum load is 1¼ tons, reference is made to Fig. 9 for R-22 suction. Entering Fig. 9 at 1¼ tons and rising vertically to intersect the 1⅜" line, it is apparent that the velocity is less than 500

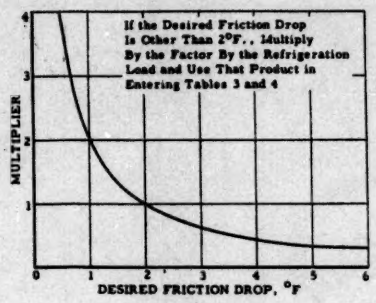

If the Desired Friction Drop Is Other Than 2°F., Multiply By the Factor By the Refrigeration Load and Use That Product in Entering Tables 3 and 4
MULTIPLIER
DESIRED FRICTION DROP, °F

FIG. 6.

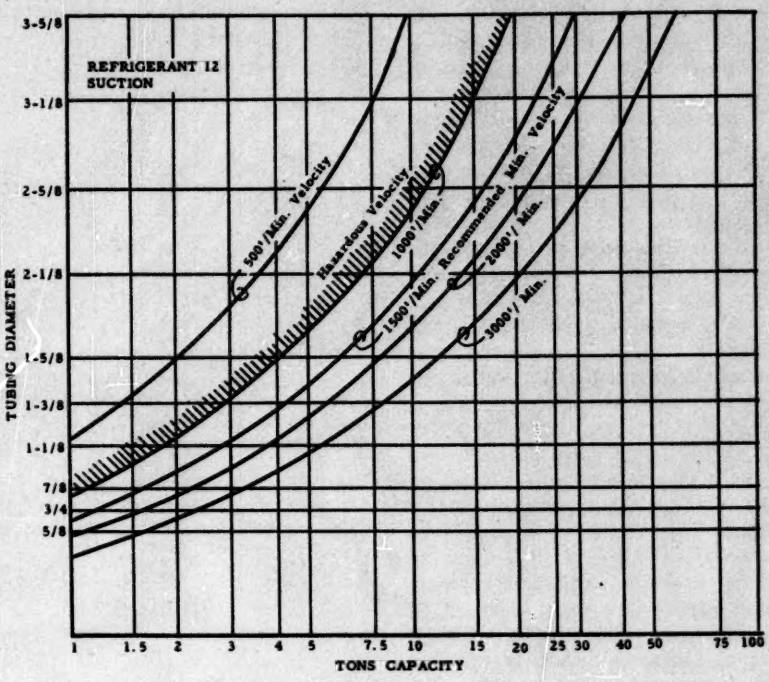


FIG. 7.

ft. per minute. Therefore, oil cannot return.

Again referring to Fig. 9, we enter the series of curves at 1¼ tons, rising vertically and see that a ⅝" tube will give the desired 1500 ft. per minute at minimum velocity. A double-riser is now placed in the line. One leg of this riser is to be ⅝" while the other is to be determined. Thus from Table 6, areas for Type K tubing are:

1⅜"	1.217
⅝"	.218
	0.999 tubing area needed.

The nearest area that can be used for the other vertical riser is the same 1⅜" tubing.

The center evaporator is next computed. In this instance, the following actual piping will be in the system.

1 ft. Horizontal run.
8 ft. Vertical rise.
50 ft. Horizontal run to vertical lift.
12 ft. Vertical rise.
30 ft. Piping inside machinery room.
101 ft. Actual length of piping.

Again assume 50 percent for fittings, and we will have an approximate equivalent resistance of 150 ft. In this case the total load from the junction of the two evaporators is 10+5 or 15 tons. Again referring to Table 4, it can be seen that a 1⅜" tube is too small for the total load and that a 2⅛" tube will be required.

However, the vertical riser carries only 10 tons at a maximum load so a 1⅜" tube should adequately carry the load.

Again it is necessary to check to determine if the pipe equivalent resistance was approximately correct. The following fittings are in this portion of the line:

2 1⅜" Elbows		@4	8
5 2⅛" Elbows		@5	25
	Total		33

Therefore the total equivalent length is 101 plus 33 or say 135 feet. The size selected will be satisfactory.

Again we must check the vertical riser to determine if the suction gas has a velocity sufficient to carry the oil back to the compressor. The minimum load is 2½ tons. Entering Fig. 8 at 2½ tons and rising vertically to the intersection of the 1⅜", it is readily apparent that the oil cannot be returned to the compressor under these conditions. The 2½ ton line intersects ⅞" tubing size between 1000 and 1500 ft. per minute curves. Selecting the ⅞" tube for minimum load conditions, we now compute the size of the other vertical riser using Type K copper tubing from Table 6.

1⅜"	1.723
⅞"	.436
	1.287 area required

The nearest standard tubing size to that required is a 1⅜" tube having an area of 1.217 square inches. This is approximately the same area, so this is selected.

Evaporator number 3 is sized in a similar manner. The total actual length of pipe between the evaporator and the compressor is computed thusly:

1 ft. Horizontal run.
8 ft. Vertical rise.
20 ft. Horizontal run to main lift.
12 ft. Vertical rise.
30 ft. Piping inside machinery room.
71 ft. Total length of piping.

Again assuming 50 percent for fittings, an approximate length of 105 ft. is indicated. Again referring to Table 4. for 100 ft. of equivalent piping, it is noted that a 1⅜" line will carry 16 tons and a 2⅛" line will carry 33 tons. These are tentatively selected for the vertical riser and the main line.

Again it becomes necessary to check to ascertain if the 50 percent allowance was approximately correct. Again referring to Table 5.

2 1⅜" Elbows		@4	8 ft.
5 2⅛" Elbows		@5	25 ft.
	Total		33 ft.

The assumed value is correct as the actual equivalent length is 71 plus 33 or 104 ft., whereas the assumed length was 108 ft.

It is now necessary to again check the size of the vertical lift for oil return. The minimum capacity is 3¾ tons. A perusal of Fig.

9 indicates that the velocity in a 1⅝" line under these conditions is lower than the critical velocity of 1000 ft. per minute. These curves indicate that a ⅞" tube will carry the refrigerant from a 3¼ ton load at approximately 1500 ft. per minute.

Consequently, the vertical pipe sizes are identical to those in the vertical riser for evaporator number 2.

The remaining problem in this suction line is to size the main vertical lift carrying refrigerant equivalent to 30 tons of refrigeration. It has already been determined that a 2⅛" tube will carry the maximum load. The minimum capacity reduction of the compressor is 7½ tons. This vertical riser would be sized for 7½ tons if there was no back pressure regulating valve in the line.

However, the amount of refrigeration effect and reduction in flow that occurs in a given evaporator when a back pressure regulating valve is installed is at best an educated guess. With a mal-functioning solenoid valve, the net refrigerant flow could be practically zero.

The general practice of the author is to assume that the smallest evaporator will be half-loaded and all other evaporators will be idle. In this condition, a total load of 2½ tons will be requiring the operation of the entire plant.

Referring to Fig. 9, it is apparent that a ⅞" tube will give approximately 1500 ft. per minute velocity under these conditions. Thus from Table 6, areas for the tubing is as follows:

2⅛"	3.014
⅞"	.436
	2.578 tubing area needed.

An analysis of Table 6 indicates that it will be necessary to utilize a 2⅛" vertical riser for the other leg as a 1⅝" pipe is entirely too small.

Reference Fig. 11 which shows an air cooled system serving an industrial process having a 15 ton load operating with a saturated suction condition of –20°F. The system is using Refrigerant 12 and it is desired to have a 2°F loss in the hot gas line and a 3°F loss in the liquid line and a 1°F loss in the suction line.

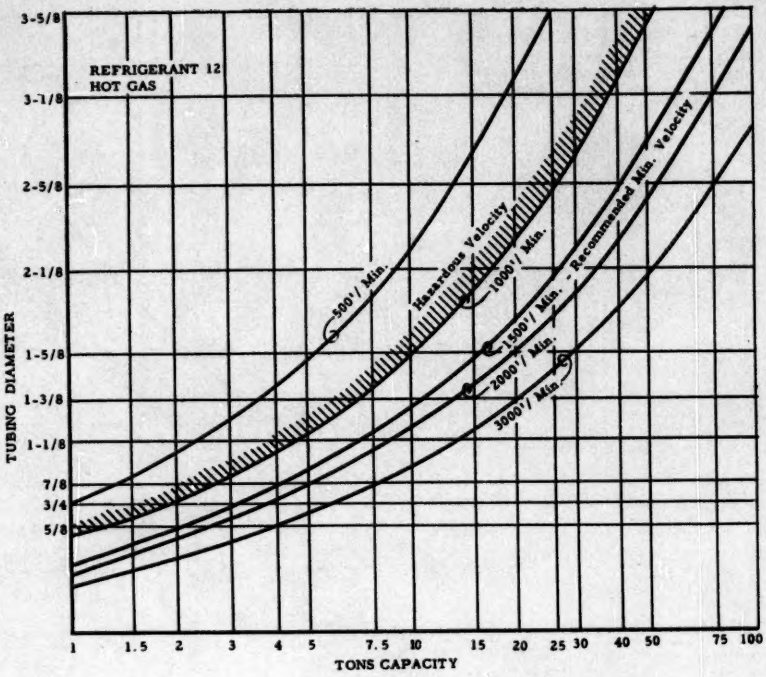


FIG. 8

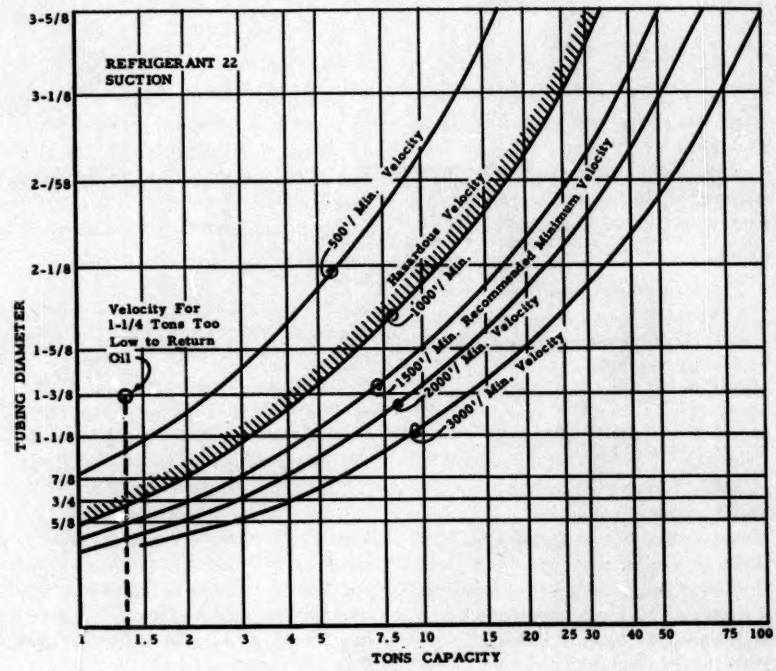


FIG. 9

The hot gas line is sized first. Reference is made to Table 3 which indicates a 1⅛" line will be satisfactory for 105°F condensing and 40°F suction. However, operating conditions are 120°F condensing and –20°F suction. To correct for this condition, reference Fig. 4 for Refrigerant-12 hot gas and enter the curve from the left at –20°F and proceed until it intersects the 120°F condensing curve. Proceed vertically and read 1.22 as a correction factor. Multiply this correction factor by the load, 1.22 times 15 equals 18.3 tons for which the pipe must be sized. In this case, the pipe must be en-

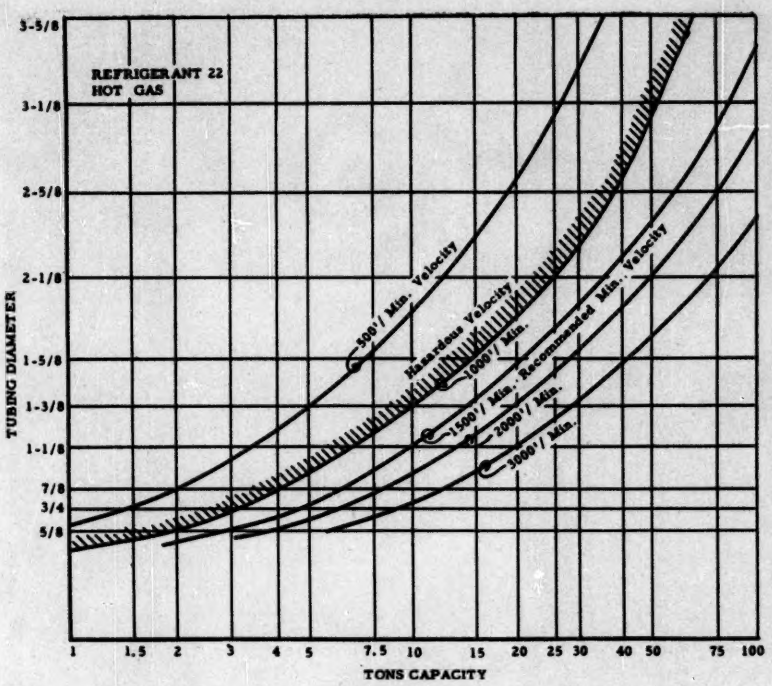


FIG. 10

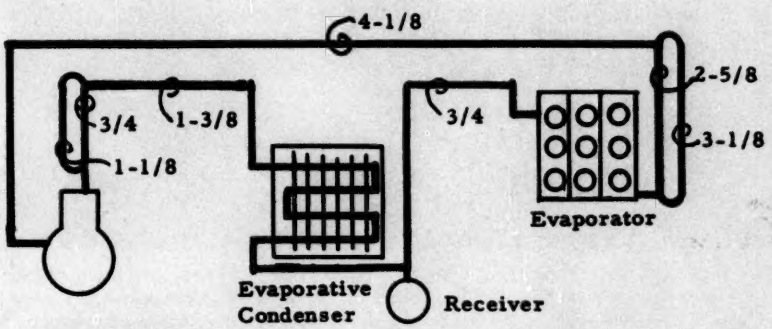


FIG. 11

larged to 1⅜" to carry the gas. At ⅓ capacity reduction, the minimum load would be equivalent to 6 tons. Checking with Fig. 8 for Refrigerant-12, hot gas, we find that the velocity at 6 tons in a 1⅜" line is approximately 900 ft. per minute, or too low to return the oil. However, a 1⅛" line will cause a velocity of approximately 1500 ft. per minute. Sizing for the vertical risers from Table 6, it is found that

The total area needed is 1⅜"	1.217
The area of a 1⅛" tube is	0.778
Area needed	0.339

This is equivalent to a ¾" tube so the smaller line is placed so that it is in continuous operation and the larger line is trapped. Thus, we get a velocity of approximately 3000 ft. per minute in the smaller line when the larger line is trapped.

The liquid line is next sized. The proposed frictional drop in this line is equivalent to a 3°F loss. Reference is made to Fig. 6 which indicates that the multiplier for this condition is 0.6. Multiplying the maximum load of 15 tons by 0.6, a value of 9 tons is obtained. Referring to Table 3, it is seen that a ¾" line will amply serve the load for an equivalent length of 50 ft. Correction is not required on liquid line sizing for these differences in head and suction.

The suction line is sized next. The total equivalent length is 75 ft. and a pressure drop of only one degree is desired. The first step is to refer to Fig. 6 and determine that the multiplier for this correction is 2. Therefore, the suction line is sized for 30 tons according to Table 3, if the system was operating at 105°F condensing and 40°F suction. It is actually operating at 120°F condensing and −20°F suction. Consequently, it will be necessary to refer to Fig. 2 and apply still another correction.

Entering Fig. 2 on the left at −20°F and proceeding to the right to the intersection of the 120°F condensing line and dropping vertically it is found that the additional correction factor is 3.8. Multiplying 30 times 3.8, we find that the line must be sized to accommodate 114 tons. This will require a 4⅛" suction line.

At minimum capacity the vertical riser must be sized for 5 tons corrected for differences in condensing temperatures. In this instance the correction factor of 3.8 has already been determined. Therefore 3.8 times 5 equals 19 tons.

It is now necessary to refer to Fig. 7 to ascertain if the gas velocity for 19 tons is sufficient to return the oil to the compressor. Rising vertically from 19 tons, it is clear that the velocity is too low even though the 4⅛" tubing is not on the chart.

It now becomes necessary to size a double riser. At 19 tons, the velocity of the gas is approximately 1800 ft. per minute for a 2⅝" line. To size for the other riser it will be necessary to determine the area of a 4⅛" tube as Table 6 does not go that high. This can be found in a catalog, computed, or by calling a supplier. In this instance it is 11.68 sq. in.

4⅛" area	11.68
2⅝" area	4.657
Total	7.023

In this instance the 3⅛" tube having an area of 6.637 sq. in. is used even though it is slightly smaller as it is much closer to the desired area than the next size.

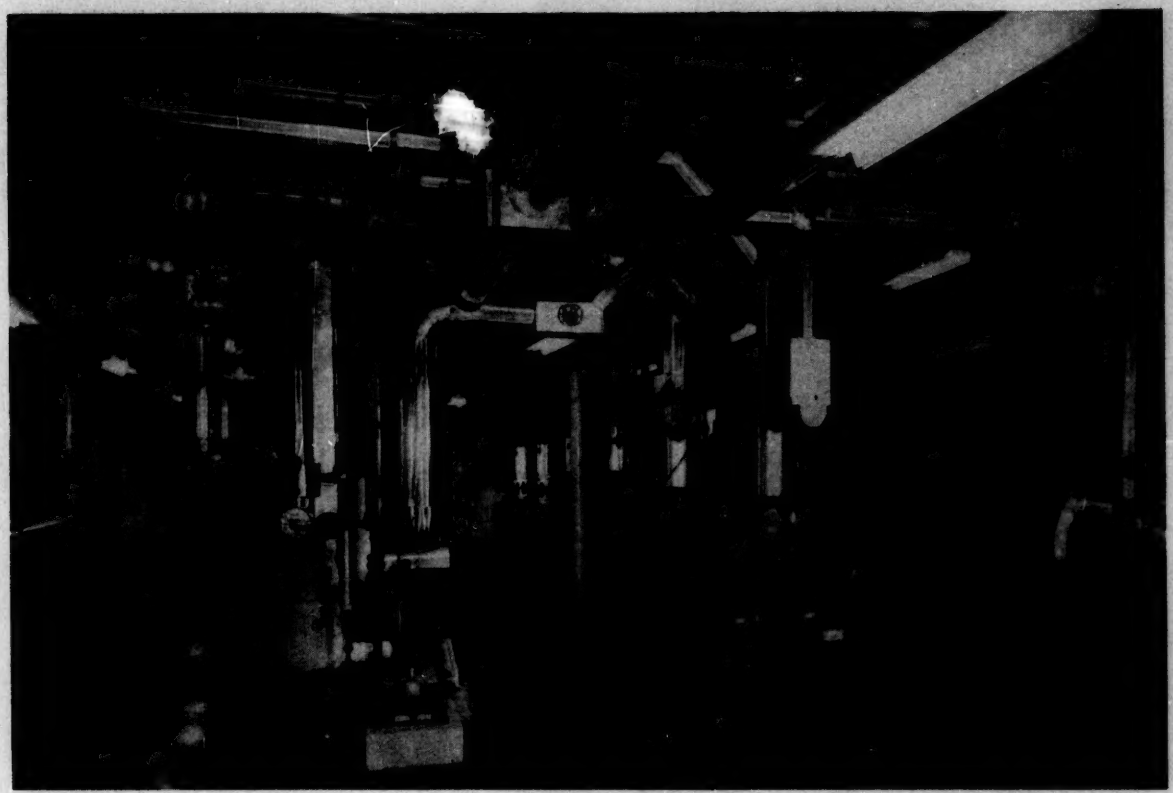
This example of sizing suction lines for extremely low pressure losses clearly points out the high costs that may be incurred by the copper tube and its insulation. It would take considerable savings in initial capacity and operating expenses to warrant deliberate oversizing of lines.

These six ammonia compressors are all high stage units at the Borden Co.'s new Milwaukee milk and ice cream plant. The 4-cylinder and 6-cylinder machines in the foreground were originally installed at Borden's old plant and were reinstalled at the new location along with four new 8-cylinder units. An oil pot for the drain from a water cooled oil separator mounted on the roof of the compressor room can be seen between the second and third compressors.

Borden's New Milwaukee Plant Refrigerates With Four Systems

Effectiveness and Operating Economy Provided in Set-up

By M. SCOTT CASSELL

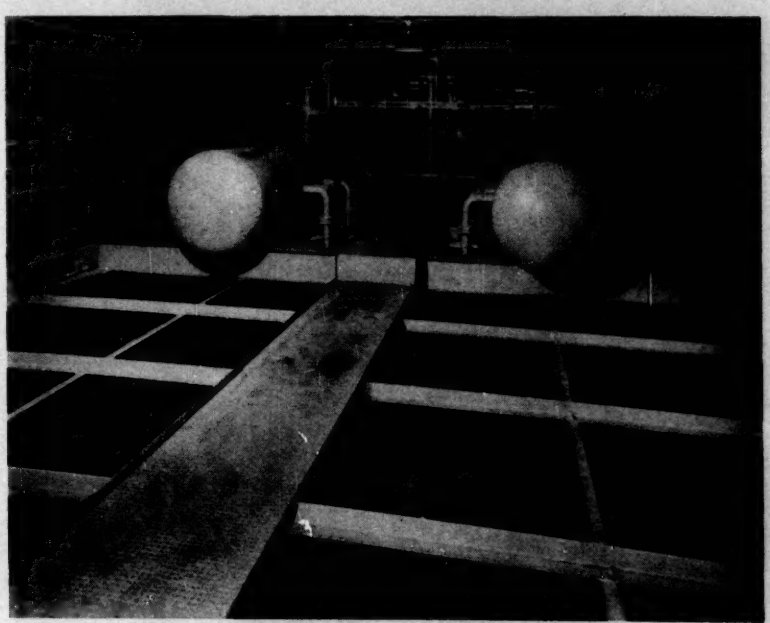


This overall view of the compressor room emphasizes the care taken both during installation and by Borden's own operating engineers. Part of the brine cooler for the ice cream bar machine can be seen to the right while the liquid receiver for the system is to the far left. The five rotary compressors are installed in a line behind the intercooler. The small vessel in the foreground piped to the intercooler is a combination oil pot and transfer drum.

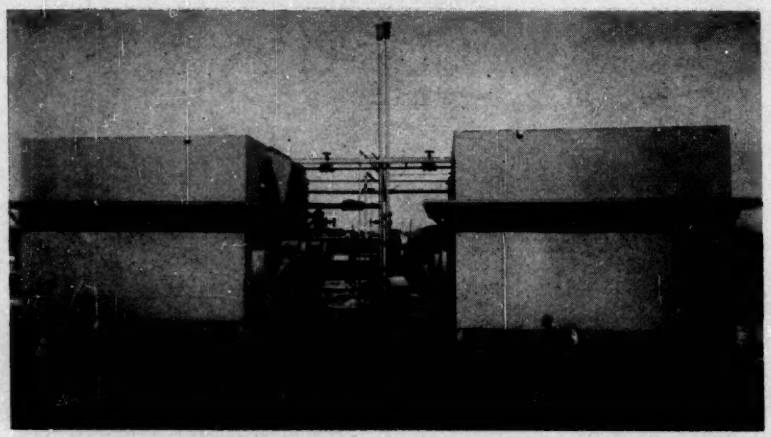
››› BECAUSE refrigeration temperatures play such a vital part in the quality of its dairy products, the Borden Company put heavy emphasis on this factor during the designing stages of its newest plant in Milwaukee, Wisconsin. With various temperatures required at different points along the route for milk and ice cream—the processing, blending, cooling, freezing, storage and shipping—the overall refrigeration problem presented a real challenge to the engineers and designers.

Several important facts had to be considered in planning Borden's new plant. Since it had been designed as a single story, 11,000 square foot building the refrigeration equipment had to be engineered to include the whole area; yet it also had to be able to maintain lower temperatures in some areas than others and to supply the freezing temperatures for ice cream hardening as well.

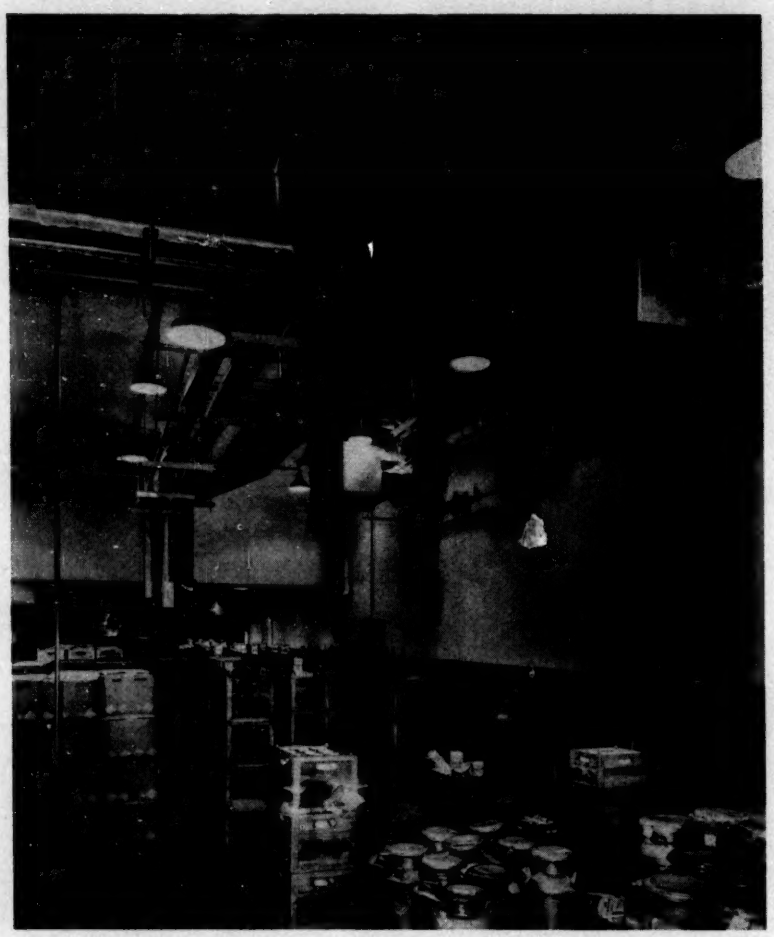
To accomplish this complex refrigeration chore most effectively, company engineers decided upon



The large sweetwater tank, housed in its own room, shows the extensiveness of the engineering planning for efficient operation. The water is maintained at 33°F in order to protect milk temperature during its processing phases from the raw milk received to the cartoned and bottled milk ready for loading into trucks. The refrigerating system that holds the water temperature also includes a ceiling mounted air cooling unit for dehumidifying the room itself.



Evaporative condensers mounted on the roof above the compressor room are connected so that one stage of the system can be cut out at other than peak load periods. Partitions through the center of each condenser offer a means of reducing capacity and maintaining desired head pressure during cold weather.



A view inside the milk cooler where fifteen ceiling mounted direct expansion type air units hold hundreds of cases of milk each day. Four of the units are rated at 11,000 cfm and the remainder at 6,600 cfm. A floor level chain conveyor moves the stacked cases down the center of the cooler to await loading into the wholesale milk delivery trucks.

the use of four different methods of refrigeration; each selected for its ability to do the job required. It was felt that a brine system would be best for making ice cream bars and specialty items which have to be immersed. A direct-expansion system offered the best means of maintaining temperatures required for the processing and storage of milk. While a flooded system, it was decided, would do the best job of holding colder temperatures required in the manufacture, freezing, hardening and storage of ice cream. Finally, a liquid recirculating system was included to charge up the cold plates in the delivery trucks; this being done at night so that the trucks would be ready in the morning.

"Dairyland Showcase"

In addition to designing their new plant for efficiency in refrigeration and operation, Borden also included a public relations twist in the blue prints. The building became a public pride of civic concern when it was announced as a "Dairyland Showcase" where visitors on guided tours could see modern equipment and methods at work, processing raw milk through various stages and bottling for delivery, or ice cream made, cartoned, hardened and ready for delivery. Built at a cost of $3,000,000.00 this new Borden operation is accomplishing both of its intended purposes well, turning out some 500,000 quarts of milk per day and 5,000,000 gallons of ice cream per year its operation must be said to be efficient; and by hosting hundreds of visitors through guided tours each month, the company's relations with the public are of an enviable nature.

Compressor Room Houses All Machinery

Modern ideas are not confined to the building fittings and appointments; operating efficiency was also streamlined in the "Dairyland Showcase" in many ways. Product processing was planned to move in orderly, labor saving routes with numerous lighted control panels to keep operators and executives informed as to exact conditions of temperature, time and products during manufacture. A special, sound-proofed room was provided

to house the refrigerating compressors and other equipment.

The compressor room is centrally located in relation to the refrigeration systems and is completely isolated from the dairy products for cleanliness and sanitation reasons. Equipment maintenance is simplified because the compressors, motors and machinery are carefully watched by operating engineers and maintenance engineers. If a breakdown occurs, it can be remedied quickly usually right in the compressor room.

Compressors mounted in this room supply the refrigeration to all milk storage areas, and to ice cream freezers, hardening tunnel, storage vault and refrigerated rooms as well as to ice water room where water from a tank is piped at a constant 33°F. to a raw milk storage area to cool the milk before processing.

There are a total of 6 ammonia Vilter compressors employed in the machine room, plus five rotary booster compressors. Four of the compressors are 8-cylinder, one 4-cylinder and one 6-cylinder.

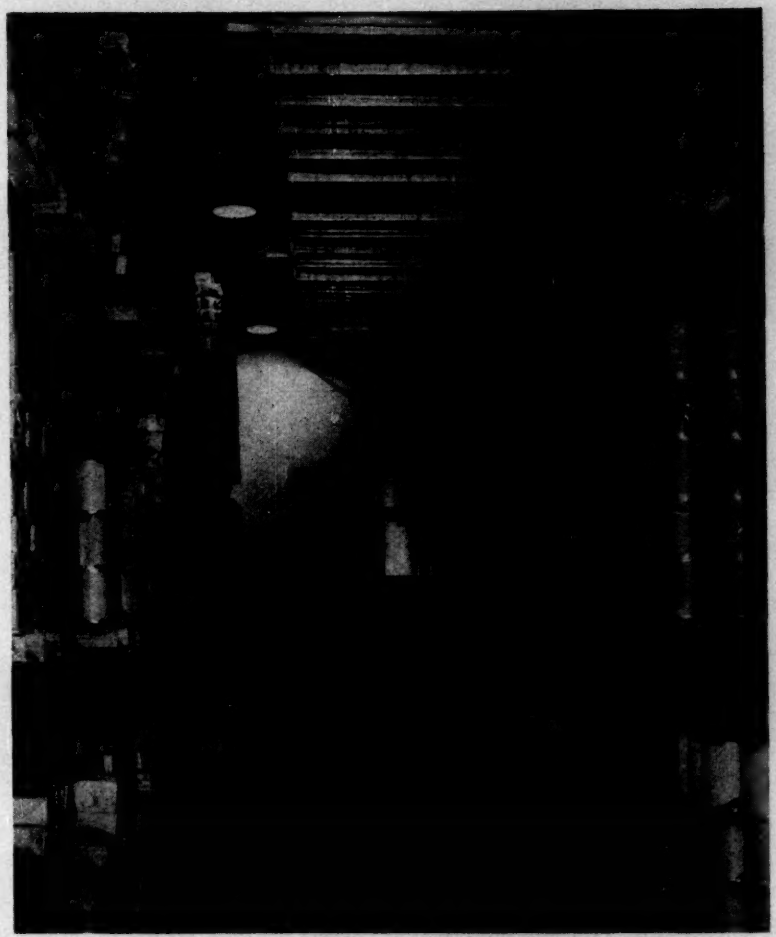
A 42" dia. by 10 ft. high intercooler separates the rotary boosters and the compressors.

Discharge from these compressors is passed through a water cooled oil separator to drain off oil particles and then the gas is passed on to two evaporative condensers mounted on the roof above the compressor room. Each condenser is equipped with two sets of propeller fans and pressure controls are arranged so that each set of fans and compressor pump can be cut-out at pre-set pressures to economize on power at other than peak-load periods.

Air units, included as a part of this system, are installed in the quality control laboratory to maintain an exact temperature there for testing and experimenting procedures.

Brine Efficient For Making Ice Cream Bars

Another modern concept in the new Borden plant is the imported, brine cooled, Gram ice cream bar machine. This unit shapes, freezes and bags some 8,400 ice cream bars in an hour; and is also used for making popsicles, froststicks or other specialty items which require submersion. Brine is used as a cooling agent and is circulated at a temperature of -25° from a brine cooler. It provides efficient refrigeration in a very simple system that does the job very well.



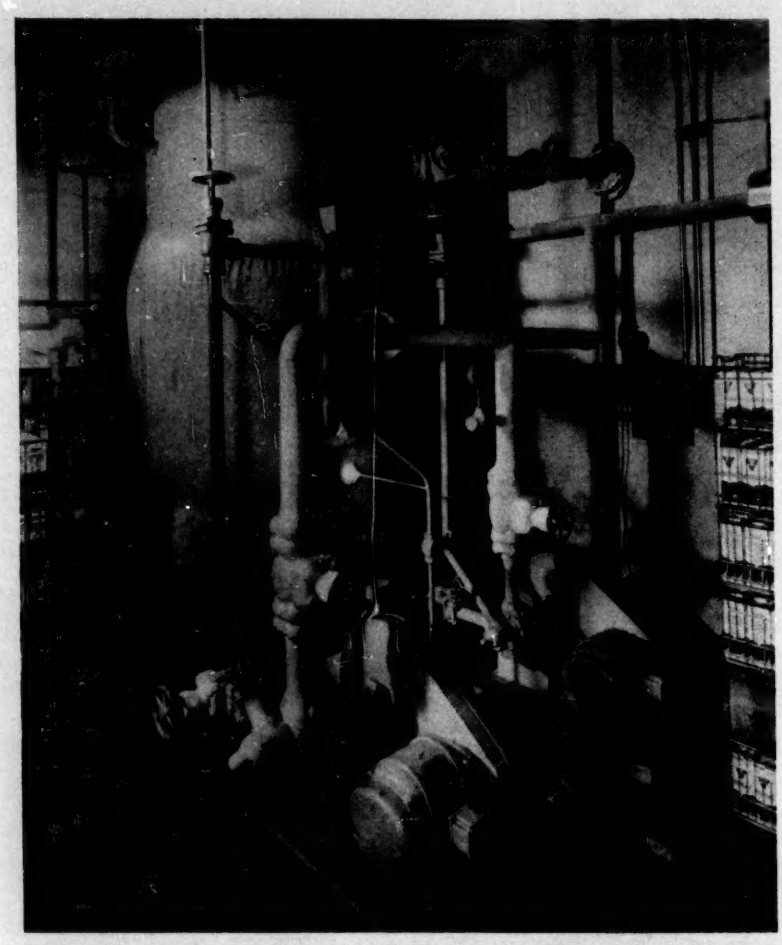
Shown is a small portion of Borden's ice cream hardening room. The Vilter hot gas defrost blast freezer is contained in the room at the end of the aisle with the cold air ducted throughout the room and distributed through registers. The large opening in the wall of the blast freezer is for return air from the room.

Flooded System Freezes Ice Cream

To achieve the low temperature required for ice cream freezing, company engineers choose a flooded system for efficiency. Both an ice cream hardening tunnel and a hardening room are used to finish and store ice cream production in the new plant; besides the usual advantages of quick freezing, the hardening tunnel also enables the use of the hardening room to palletize most of the ice cream production for a most efficient use of space.

The temperature of the hardening tunnel is maintained at -30°F. to -40°F. by two long fin coils. Eight axial flow type fans with direct operated shutters circulate the refrigerated tunnel air over the coils. An air unit has also been installed in the tunnel anteroom for dehumidification. As the ice cream packages enter the hardening tunnel, they are distributed evenly on a large, slowly-moving conveyor. Four hours are required for a package to complete its trip through the tunnel.

After the ice cream leaves the tunnel, it enters the hardening room which is held at minus 20°-25°F. by a hot gas defrost blast freezer with a galvanized fin coil. Air from the blast freezer is ducted throughout the room and distributed over the product through



This liquid recirculation system circulates ammonia to the forty-four wholesale milk truck charging positions located off the milk cooler. A fully automatic system, the two 30 gpm pumps are started at a predetermined time and operate for the time required to refrigerate the trucks. The liquid feed is then stopped and the ammonia is pumped out of the trucks. To prevent the pumps from running dry, a low level cut-off stops them if the liquid level in the low pressure receiver gets too low.

registers placed at strategic locations.

Liquid Recirculating System

The truck charging liquid recirculating system—a low pressure receiver and two liquid recirculating pumps—is located inside the milk cooler. Eleven truck charging positions are available for Borden's ice cream delivery trucks and forty-four truck charging positions are located off the cooler to accommodate the large wholesale milk delivery fleet.

One of the largest sweetwater tanks ever built, and the largest installed in the state of Wisconsin, is used to chill water which in turn holds the pasteurized milk storage tanks at 38°. The tank is 50 feet long, 18′-8″ wide, 7′-6″ deep and contains 11,520 lineal feet of 1¼″ pipe. 670,000 gallons of water are chilled to 33° each day. After bottling, the milk is conveyed into the milk cooler where it is held until loaded into delivery trucks. Fifteen ceiling mounted air units provide the refrigeration necessary to hold the required temperature in this vast cooler.

This installation, utilizing four different refrigeration systems, seems to us to be a mighty fine example of the way in which proper planning before construction can pay off in efficient operation. Good application engineering is always worthy of a compliment.

Sunkist Largest for Lemon

»» THE largest sub-zero warehouse in the world devoted solely to the storage of lemon juice products is now even larger.

Located at Corona, California, the warehouse is used to store lemon juice concentrates and other citrus products of the Lemon Products Division of Sunkist Growers, Inc., the world's largest citrus cooperative.

The warehouse has been the largest of its type since its first day of operation of 1953. Over-all dimensions, exclusive of docks, are 260 feet by 164 feet, for a total area of 43,000 square feet. Built this year was an extension measuring 182 feet by 164 feet to provide 26,240 additional square feet of storage space and a 21-foot wide access corridor.

In terms of storage capacity, results are staggering: Two and one-half million cases of lemon juice concentrate can be stored in the enlarged facilities. That's enough to fill more than 330 large mechanically refrigerated cars. To put it another way, more than enough concentrate can be stored at one time to make large glasses of lemonade for every American.

While adding storage quantity, Sunkist also took pains to maintain and improve upon storage quality.

For instance, most of the storage space is kept at a temperature of -10 degrees F. Since the additional space doubles capacity at that particular temperature, special efforts were made to insure efficiency of insulation.

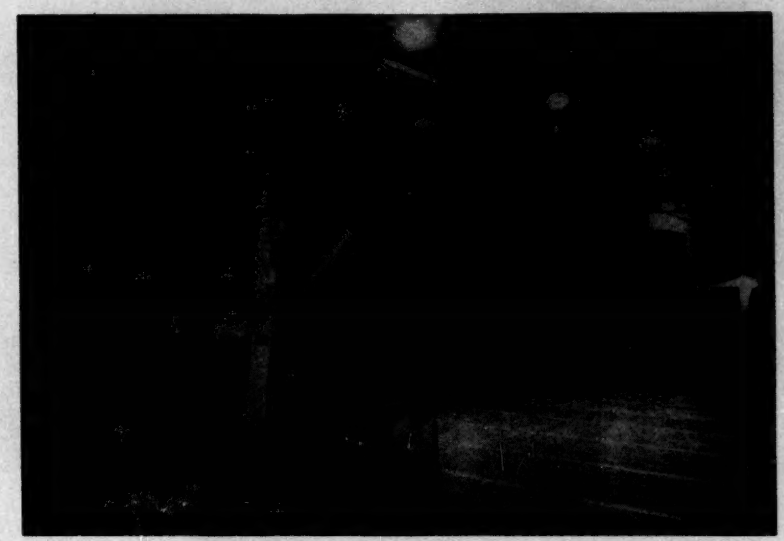
This was done in two primary ways: by using insulation methods that had proved out in the segment completed in 1953, and by adding new insulating methods developed since then.

As in the older section, cork was used to insulate the walls—seven inches for exterior walls and six inches for interior walls. Together with the first section built, about 30 carloads of cork have been used in the building.

For floor and roof insulation in

Warehouse Products Expanded

New extension to huge Sunkist warehouse at Corona, California, adds 26,240 square feet for cold storage of lemon juice products.



Enlarged Sunkist facilities can accommodate two and one-half million cases of lemon juice concentrate. Floor and roof use plastic insulation.

the new section, Sunkist turned to plastics.

The floor was insulated with a total of six inches of Styrofoam, the plastic foam material manufactured by The Dow Chemical Company. An asphalt prime coating was applied to the 6-inch concrete sub-floor. Two layers of Styrofoam—a three-inch layer rolled with hot asphalt, laid on the primed sub-floor, followed by a three-inch staggered layer laid dry—were installed. Finally, a five-inch layer of reinforced concrete was poured on the top layer.

The roof was insulated with a combination: Styrofoam and Roofmate, the newest member of the Styrofoam family of insulation products which is designed specifically for insulation under built-up roofs. Roofmate is composed of a two-foot by four-foot board of Styrofoam completely enclosed in an asphalt laminate Kraft wrapper.

After laying down a plywood roof structure and a dry sheet of 15-pound felt, asphalt was mopped on the felt. A four-inch layer of Styrofoam was then installed in the asphalt before it was cooled.

A second layer of three-inch Styrofoam was coated on one side with asphalt by passing over a roller coater and laid in place on the bottom four-inch layer. The asphalt acts as an adhesive. The final layer of one-inch Roofmate was also coated with hot asphalt and then placed over the top layer of Styrofoam.

Since Roofmate was a new product, particularly in the West Sunkist engineers lacked detailed knowledge of its qualities when planning of the addition was started. However, it was recommended by the project's insulation contractor (Los Angeles Cork Company), and Sunkist agreed to its use partly because the firm has been named an Approved Insulation Contractor by Dow.

At the Sunkist warehouse, Roofmate eliminated the need for special vapor barriers, proved easy to apply, provided a firm base for built-up roofing materials—and, of course, shares the permanently low heat transmission qualities of Styrofoam.

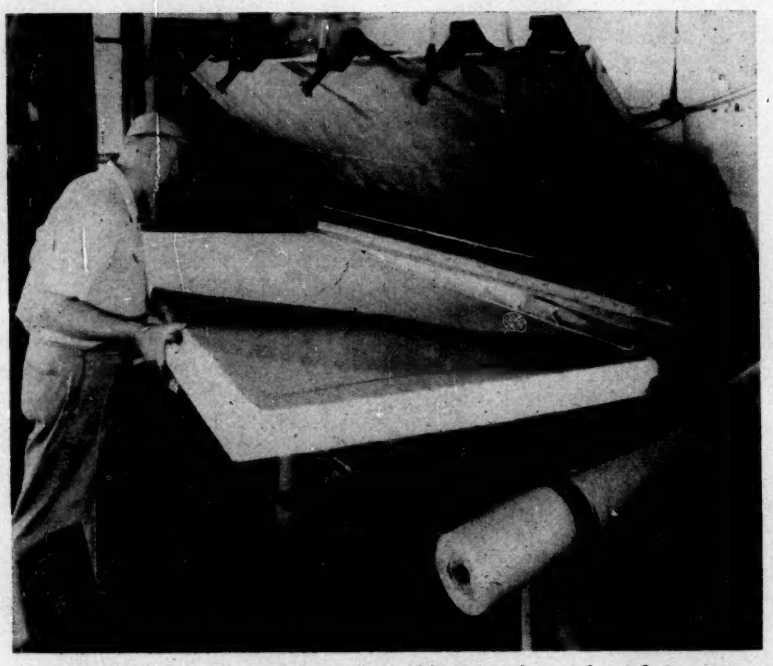
Sunkist found that the top layer of Roofmate has other advantages, too. For instance, its strength allows the wheels of carrying vehicles to be run directly on the Roofmate during construction, a fact which insured against loss of insulating effectiveness due to damage to the roof insulation. In addition, the underlayers of Styrofoam were protected from any possible damage from asphalt, which was mopped on at a temperature of 375 to 400 degrees F.

Products to be stored in this huge warehouse are produced in the adjoining products building where a continuous freezing tunnel feeds the casing lines with the frozen lemon products. The tunnel is 85 feet long by 21 feet wide and 22 feet high. Its total capacity is 63,000 six-ounce cans per hour on a basis of one-hour freezing. Tunnel temperature is kept at a constant -40 degrees F.

The result is that the Sunkist facilities at Corona are now prepared to receive as much as 1,200 tons of lemons a day, and to have the concentrate stored in its giant warehouse within 24 to 36 hours—ready to quench the thirsts of the world's growing number of lemonade drinkers, no matter how far they live from the world's lemonade capital.

Workman pouring blended liquids into mold. With foaming underway, the mold top will be clamped secure as soon as the pour is complete.

Refrigerated Trailer Meets AFDOUS Code With New Insulating Methods



Completed panel is removed from the mold. Foamed in 4 by 8-foot sections, the panels can be easily fabricated to meet many special requirements.

»» INTRODUCTION of the AFDOUS code requirements in the frozen food industry has raised one question in the minds of transporters: Can we insulate our trucks well enough to hold frozen food shipments at sub-zero temperatures on long hauls?

The code, adopted by the Association on Food and Drug Officials of the United States, requires that all shipments of frozen foods must not exceed zero degrees Fahrenheit during transit. Three states have already made the code a requirement, and other states are expected to follow suit shortly.

The answer hangs entirely on insulation. Many of the materials used today are far too inadequate for the sub-zero temperatures suddenly required by the new AFDOUS code.

Alert haulers, realizing what is at stake, are seeking new methods in refrigerated truck design. New insulating design, different flooring and gasoline-engine driven compressors are all being considered.

Indications show that an answer has been found in a new design concept developed by Dynafreeze Corporation of Camden, N. J., using Nopco Lockfoam as an insulating material. Tests now being conducted are bearing out that the new methods are by far the best developed. Results have shown that minus 10 degrees F. with an outside temperature of 100 degrees F. is assured, with minus 25 degrees F. under normal operating conditions likely.

Howard Matthews, president of the Camden, N. J., organization is familiar with the problems of cold storage transportation. In 1933, prompted by the lack of fresh sea food in the mid-west, Matthews started the Matthews Trucking Corporation to haul fresh sea food from Boston, Mass., to markets in the mid-western states. Starting with one unit and small working capital, the company grew to be the largest refrigeration operation in the country.

By 1946, a total of 260 units covered 32 states, providing fast deliveries of frozen cargos. Foreseeing the need for new methods in the design of refrigerated trailers, Matthews formed a partnership with William Warren to form

Dynafreeze Corporation in 1957. Warren, vice-president of the firm, was general manager for one of the nation's largest frozen food carriers before his relationship with Matthews.

The original purpose of the newly formed company was to develop a mechanical unit which would maintain minus 30 degrees F. in a trailer for extended periods of time. They soon developed a unit to do the job at 36,000 Btu per hour, but discovered that there was not a trailer available with sufficient insulating qualities that could hold the low temperatures once they were developed.

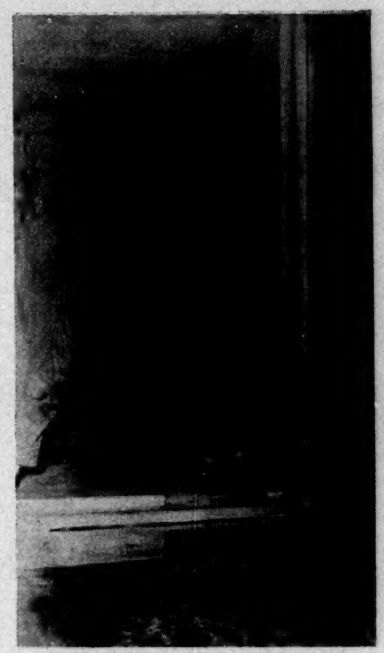
Realizing the need for new insulating methods, Dynafreeze decided to meet the challenge. After exhaustive tests which included all of the most modern types of insulating materials available, Matthews was convinced that only one product could do the job—urethane foam. After an extensive research program, Nopco Lockfoam was proved to be the foam for the job.

Nopco Lockfoam is a urethane plastic foam with exceptional insulating qualities (K Factor .13) that can be poured into place as a liquid mixture. The subsequent foaming, as chemical reaction proceeds in the mixture, expands the plastic so that it entirely fills the cavity or void with a low density homogeneous solid.

Other insulating materials, while doing a fairly effective job, had a number of drawbacks. Fiberglass, made into 6 x 12 inch batts, was vulnerable to moisture absorption and grew heavier and less efficient. The increased weight reduced permissible payload. Also, by absorbing moisture, the fiberglass contributed to rust and corrosion in the truck's body. The batts, shifting in transit, permitted air spaces to develop causing eddy currents that contributed to heat loss.

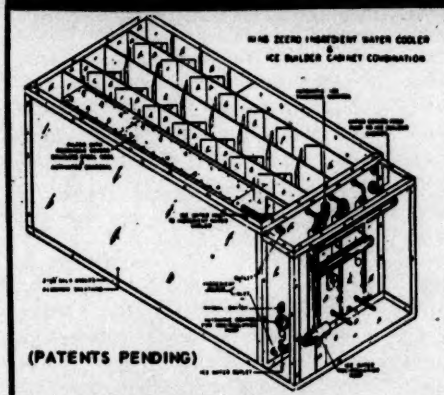
The moisture decreased the insulating value of the fiberglass, and the air spaces permitted leakage which could raise temperatures and lead to cargo spoilage if not carefully watched.

Polystyrene foam, another considered insulator, absorbed almost no moisture and was equal to fiber-



Ease of installation is demonstrated as workman places a floor panel in a 16-foot truck body. Only 3-3/4 inches thick, the thin panels free valuable space to permit greater payloads for the carrier.

For Ideal Filtered Ingredient Water at Low Cost



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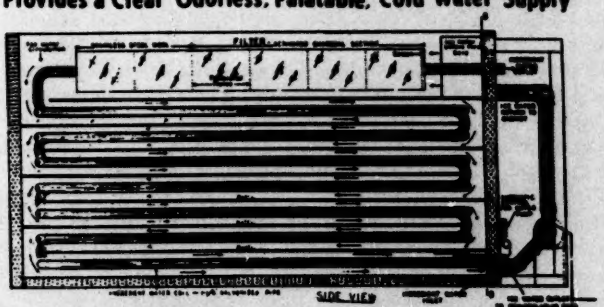

The KING ZEERO Pure Water Cooler consists of a galvanized pipe water coil, a self contained efficient charcoal filter, a KING ZEERO Ice Builder and an ice water recirculation pump, with controls and necessary valves for flow and back wash, all contained in an integral unit

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Howard Matthews, president of Dynafreeze Corporation, points to method of joining the panels together while William Warren, vice-president, holds the cutaway sample. Design of the joint (patent pending) provides six inches of surface to seal panels together effectively and prevent any heat leaks.

glass as an insulator, but chafed at the sides and corners causing uninsulated spaces.

Matthews says Lockfoam has none of the disadvantages of fiberglass or polystyrene foam.

The method of installing the foam insulation is unique. Dynafreeze developed a special mold in which 14 by 8-foot panels are foamed with a novel mating joint. Patent has been applied for to cover the method of mating. The size of the foamed panels can be adjusted to meet the requirements of individual needs.

Foaming of the panels begins with placing of a 4 by 8-foot panel of ¼-inch exterior-grade plywood in the bottom of the master mold. The plywood will form the interior wall of the trailer when the panel is installed. The dies which form the mating joints are then placed in their proper positions.

Although the mixing of the two-component Lockfoam system is being done with a hand mixer, an automatic dispensing machine is now being installed. The machine will automatically mix the foaming agents and meter the precise amount required into the mold. Immediately after the foaming agents are poured, a sheet of paper is placed between the foaming mass and the mold top as a releasing agent. The top of the mold is then clamped in place.

The Lockfoam used weighs two pounds per cubic foot. Once the foaming begins the foam expands to fill every crevice of the mold. The material has tenacious bonding characteristics and, once poured in place, adheres tightly to all enclosing surfaces. Because of this quality, it has high structural values.

The completed panel is 3¾ inches thick and weighs only 44 pounds. Easily handled by one man, a 35-foot trailer can be completely insulated in half a day using a two-man work force.

To facilitate operation of fork trucks within the trailer the floor panels are foamed with a ¾-inch exterior grade plywood face and 2 x 3-inch supporting ribs. The panels are placed in the trailer shell with the ribs perpendicular to the floor stringers of the trailer. Topped with a sheet of extruded aluminum, the floor meets all requirements for fork lift operations and long life.

The ceiling panels are the first to be installed. The side walls are then put in position with the floor panels the last to be placed. Using urethane base mastic cement—especially developed for Dynafreeze—at all panel joints, the insulation completely seals the trailer with urethane foam. The result is a body within a body with no metal-to-metal contacts between the interior and exterior of the unit. The new design reduces overall weight of the trailer and strengthens the trailer envelope. This strength is especially valuable in case of accidents where trailer walls could be damaged.

The foam has excellent impact resistance. Thus, if an outside wall is dented or breached, the envelope will usually remain intact and protect the frozen merchandise inside. Repairs can easily be made by replacing a partial or full panel in a matter of minutes.

Quoting Matthews, "We get savings in space and weight in the trailers. Fiberglass batts, two inch es thick, were in many instances packed three deep, making a total of six inches all around. Because a 3½-inch wall of urethane foam is equal to eight inches of fiberglass or styrene foam in insulating qualities, this alone means savings of over 30 percent in weight. Where the other types of insulation absorb 1500 to 2500 pounds of moisture in the first year of operation, depending on the usage, Lockfoam is virtually unaffected by moisture—retaining all of its insulating qualities and preventing, instead of causing, rust and corrosion.

Because of the effectiveness of the insulation, the mechanical refrigeration units don't have to operate as often as in older trailers. On long hauls this saves 20 percent in refrigeration unit operation."

The first firm to use trailers with the new design concept is Transit Freeze Corporation of Wilmington, Del. According to Robert Janko vice president, "Transit Freeze tested all types of insulation before turning to urethane foams. Our only regret is that we did not find the material sooner. Tests now being conducted prove beyond a doubt that urethane foam is the answer to our needs. As an example, we were able to drop the temperature in a 35-foot trailer from 70 degrees F. to minus 20 degrees F. at better than a degree a minute. That's performance!"

According to Warren, of Dynafreez Corporation, "This is only the beginning." Not only does he see use of the panels in new trucks and in conversions of trucks now in operation, but also in the construction of refrigerated warehouse and storage areas.

Frozen Food Association of Delaware Valley Elects Officers

»» AT ITS annual election on Monday, October 17, the Frozen Food Association of Delaware Valley elected Officers and Board Members for the 1961 term. The number of members voting totaled more than one hundred, representing two-thirds of the active membership.

The Officers elected are President, William Spence; 1st Vice President, Jack Oritt; 2nd Vice President, Robert De Lorenzo; Secretary, Chuck Hagerty; Treasurer, William Mathers; Sergeant at Arms, Nick Martin. Board Members are as follows: Robert Seymour, Murray Reidel, Carl Wil-

liams, Alvin Oritt, and Robert McKenna, with retiring President William J. Clements as Board Chairman.

The annual combined meeting of the Officers and Board who served during 1960 and the newly elected Officers and Board was held at the Embers Restaurant in Camden on Monday, November 7. Retiring President and new Board Chairman, William J. Clements, reviewed the year just ending, and charged the new Board with its responsibilities for the year ahead.

Here's How You Can Remove Ammonium Carbamate From Ammonia System

»» AN article entitled "Don't use CO_2 To Test Ammonia Systems" appearing in the October issue of INDUSTRIAL REFRIGERATION told what happens in the system when ammonia and CO_2 mix. Now comes a letter from Lyell H. Carver, Jr., of Deady Chemical Company, which offers an easy way to remove the white crust that forms due to the reaction of CO_2 and ammonia. The letter follows:

Editor: "We noted the article on page 6 of INDUSTRIAL REFRIGERATION for October, 1960, relative to the interesting report of reaction between carbon dioxide and ammonia gases.

"Your warning to your readers not to use carbon dioxide where ammonia can be contacted is timely, and certainly a warning with which we agree.

"However, should it occur, your readers should not be unduly alarmed, as the reaction product usually can be readily removed.

"Ammonia and carbon dioxide react quite readily with each other at room temperatures. The reaction product is ammonium carbamate, a white crystalline powder with a strong odor of ammonia.

"This material is relatively harmless, and is readily soluble in water. Should such a deposit occur, circulation of warm water through the pipe usually can remove the material without difficulty. No acid need be used. Of course, afterwards, all traces of moisture should be removed as far as possible."

Institute of American Poultry Industries To Meet In Kansas City In February

»» "NEW Departures in Marketing" will be the theme around which the Institute of American Poultry Industries will build its 32nd Fact Finding Conference next February 10, 11 and 12, Harold M. Williams, IAPI president, has announced.

The three-day session for management men from companies that process and market most of the nation's chickens, ducks, eggs and turkeys will be held in Kansas City, Missouri. Nearly 4,000 are expected to attend.

"The Harvard Business Review recently said that marketing is preoccupied 'with the idea of satisfying the needs of the customer by means of the product and the whole cluster of things associated with creating, delivering and consuming it,' " Mr. Williams said. "We have heard it said recently that marketing is indeed the key to everything . . . that unless we market our production profitably everything else is academic. Certainly this is true! New marketing ideas, new marketing outlets, new marketing methods . . . philosophies, strategies, overall general planning . . . will be given a thorough going over as the 'Super Jet' 1961 Fact Finding Conference takes off on February 10."

Dramatizing the jet-age theme, the IAPI will transform Kansas City's Municipal Auditorium into a giant "air travel center." Program operations will include daily marketing "flights" under the command of skilled "flight captains" and a "crew" of experts on new concepts in marketing.

There will be daily "tours" through the four acre center of equipment, supplies and services designed for today's jet-age operations.

"In flight" alongside the Fact Finding Conference will be the special section devoted to high school boys and girls—Future Farmers of America, Future Homemakers of America and 4-H—the 8th Junior Fact Finding Conference.

Through these junior sessions industry hopes to do a better job of bringing high school students a picture of poultry and egg operations and the opportunities awaiting them in this field.

"Flight plans" for the 1961 Fact Finding Conference are yet to be finalized, the IAPI said, but hotel reservations now are important. Invitations to industry went out this month.

Details on hotel reservations and conference exhibits are available from the Institute's office, 67 E. Madison St., Chicago 2, Illinois.

Technical Report On Refrigerated Storage Installations

»» ROBERT M. Dillon, executive director, Building Research Advisory Board, announces the availability of a technical report of the Federal Construction Council, Technical Report No. 38, Refrigerated Storage Installations.

A task group composed of engineers from the major Government agencies, appointed by the Operating Committee of the Federal Construction Council, has prepared design criteria and selection procedures for Refrigerated Storage Installations. The report primarily deals with vapor barriers, insulations, and interior finishes, and their installation. The major part of the data, upon which findings are based, were collected in a nationwide inspection and survey of Government and private cold storage facilities by a team of engineers appointed by the Federal Construction Council. The results of an analysis of forty-four installations in the continental USA are reported.

This report may be ordered by title and/or NAS-NRC Publication Number (759, Refrigerated Storage Installations), from the printing and publishing office, National Academy of Sciences-National Research Council, 2101 Constitution Avenue, Washington 25, D. C. The price is $2.00. Discounts are available for quantity orders.

Wear Your Safety Goggles This Accident Points Up Need

»» "I MANAGED to get down off the ladder. My eyes were filled with ammonia. I crawled on my hands and knees to where I thought the water hose would be. I couldn't see, and I had to be sure that I didn't turn on the steam tap by mistake."

That's how Charles W. Haetler describes the first terrible moments of his blindness. The moments when his whole world had changed, when each second seemed to be toiling away the most precious gift: eyesight.

Charles Haetler already had 30 years of experience as a maintenance mechanic when he joined Sealtest Baltimore in 1946. Since that time he has been a member of the maintenance department, dividing his time between the milk plant on Linden Ave. and the nearby bread plant. He had never had a serious accident while working. Then came the day of June 2, 1959.

The maintenance crew had a tough assignment. An ammonia pipe had burst in the ice tank, filling the ammonia lines in the milk plant with sludge. As a result, all coolers had to be drained of ammonia, and the sludge cleaned out.

On June 2, Charlie was working on the cooler in the milk storage room. He mounted an 8-ft. ladder and opened the flange on the ammonia pipe. The raw ammonia, many times stronger than household solutions, drained out. Charlie started down the ladder to get the tools necessary to remove the sludge.

But somehow, some ammonia had remained in the pipe. As he descended the ladder, Charlie was for a split second at eye level with the open flange. In that instant, the remaining ammonia gushed out, splashing squarely in Charlie's eyes.

It is a mark of Charlie's courage and cool-headedness that he was able to locate the water hose while his sightless eyes burned with pain. He found the right valve, turned it on, and sprayed his eyes with water. With much of the ammonia washed out, the stricken mechanic could distinguish light and dark shapes.

He made his way across the loadout yard and up a flight of stairs to the maintenance shop. There, Supervisor Allen Alban and Mechanic Woodrow Richter, unaware until that moment that the accident had occurred, administered first aid in the form of eye salve. Then Charlie was rushed to Baltimore's Mercy Hospital.

For the next 10 days, Charlie Haetler lay in a hospital bed, wondering whether he would ever see again, wondering whether the last time he had seen his family and friends and the familiar scenes of a lifetime had indeed been the last time. And Ida Haetler, his wife of 34 years, and their three married children all waited, and hoped.

During that 10 days, two operations were performed on Charlie to remove adhesions on his eyes. Every two hours, around the clock, salves and drops were applied. At those times, Charlie could see light and dark. The rest of the day he lay with a mask on his face, a mask to hold in place the two bandages that covered his eyes.

At the end of the 10 days, his doctors told Charlie he would see again. The water he had sprayed in his eyes immediately after the accident occurred had saved his vision. Charlie remained in Mercy Hospital for 13 more days, while his sight gradually returned. The bandages were removed and he wore dark sunglasses.

Then the sunglasses were discarded in favor of a green eyeshade and a new pair of prescription eyeglasses. On July 6 Charlie went back to work, a man almost miraculously returned from the dark and shapeless world of the blind.

Today, Sealtest people who work around ammonia wear safety goggles, the result of a lesson painfully learned. To those who feel the goggles aren't always necessary, Charlie has a brief recommendation: "Put them on." And then, remembering those 10 days of blindness, he adds simply, "I know I always will."

—National Safety News

Silverwood Elected President, Mayfield V.P. of Ice Cream Manufacturers

»» GORDON Silverwood, president of Silverwood Dairies, Ltd., London, Ontario, became the first Canadian to head the International Association of Ice Cream Manufacturers. Mr. Silverwood was elected president of this worldwide trade group during its 16th Annual Convention in Chicago, October 31-November 2.

He succeeds I. N. Hagan, I. N. Hagan Ice Cream Company of Uniontown, Pennsylvania.

Mr. Silverwood is a dairy industry as well as association veteran. When he was 14 he hauled buttermilk for his father's dairies. During summer vacations—and until graduating in business administration from the University of Western Ontario in 1925—Mr. Silverwood worked in the Silverwood Creamery plant.

He is a past director, executive committee member and vice president of the International Association which represents over 2,000 ice cream manufacturers and suppliers throughout Canada, the United States, and abroad.

Tennessee Man Elected Vice President

Thomas B. Mayfield III, President of Mayfield Dairy Farms, Athens, Tennessee, was elected vice president of the Association.

Mr. Mayfield was educated at the University of Tennessee and lives at the Mayfield Dairy Farms. This is an independent dairy products company owned and operated by the Mayfield family.

He was reared in the dairy business and has grandparents on both sides of the family who were dairy farmers. His father, T. B. Mayfield, Jr., entered the ice cream business in 1921 with a salt and ice cream freezer with a capacity of 10 gallons per hour. He built a milk pasteurizing plant in 1924. Presently, the Mayfield plant is one of the most modern in the south.

A Warning About Turkeys

»» WITH the return of the traditional turkey season, The Refrigeration Research Foundation suggests it would be wise to refresh the minds of key operating personnel on the following points:

1. Turkeys are extremely susceptible to "freezer burn" and the true market value of the birds can be lost if this surface marring occurs. "Freezer burn" is a dehydration (loss of moisture) on the surface of the birds and results in a skin condition much like chapped hands on a human being. Although it does not spoil the eating quality, the appearance of the bird at time of purchase is not pleasing, and the skin and meat directly underneath can be slightly tough.

Moisture-vapor proof packaging materials prevent "freezer burn" from occurring. Most turkeys today have the proper packaging material around the individual birds, but if the wrapper or bag is broken, dehydration can occur in the warehouse freezer rooms.

2. Turkeys frozen slowly can develop an unpleasant reddish discoloration of the skin and surface meat. Good handling practices for frozen turkeys are recommended as follows:

A. IF THE PRODUCT IS +10° F. OR BELOW, it can be assumed that the product has high quality and every effort possible should be made to retain that quality. To prevent any loss, the product should be placed in a room at 0°F. or below within an hour. It is not necessary to provide air circulation betwees cases unless the product temperature rises above +10°F.

B. IF THE PRODUCT TEMPERATURE IS BETWEEN +10° F. AND +25°F., damage to the quality is about to begin, or may have actually begun. To prevent further development of damage, the product should be placed in a room at 0°F. or below, with spacers between cases to provide removal of heat by air circulation.

C. IF THE PRODUCT TEMPERATURE IS ABOVE +25°F., damage to quality has begun and immediate steps should be taken to prevent further damage. The product should be placed in a blast freezer or equally rapid freezer, with spacers between cases to permit air circulation and rapid temperature drop. Cases should not be removed to storage rooms or restacked until product is at +10° F. or lower.

3. Immersion frozen (white crusted) turkeys should not be permitted to rise above +10°F., or the crusted surface will melt and evaporate, losing the desired appearance. Sometimes immersion frozen turkeys are delivered to a warehouseman for completion of the freezing process and these turkeys should receive special handling. When this is the situation, the bird is crusted and frozen to a depth of only one half inch or so from the surface and there is considerable heat left in the bird which should be removed. Blast freezing, or at least freezing at 0°F., with spacers between cases, is necessary to maintain the surface crust and prevent undesirable flavor changes in the meat next to the body cavity.

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DESIGNERS AND ENGINEERS/REFRIGERATION CONTROL SYSTEMS

Evaporative Condenser or Cooling Tower

Which Should You Use And When?

»» ONE OF the questions asked the author concerns the relative merits of cooling towers and evaporative condensers and when to use each. There are no hard and fast rules that can be applied nationwide, or for that matter to a small locale. Each individual installation must be judged on its own requirement. However, there exists certain generalities which are acknowledged by most authorities to be correct. Knowing these and knowing the primary advantages and disadvantages of each type of condensing method will generally permit the designer to make an appropriate decision.

The first generality is that packaged or unitary refrigerating systems of the smaller type dictate the use of water cooled condensers. This equipment comes with a water cooled condenser as it leaves the factory. While these units may be procured on special order without the condenser, the factory generally adds an additional charge for special processing. Sometimes this charge is in excess of ten percent of the factory cost of the condenser and refrigerant.

The field installation of evaporative condensers to unitary type refrigerating systems actually defeats the purpose of the unitary equipment which is to permit standardized designs, repetitive pipework, semi-skilled labor for fabrication, and the use of jigs, fixtures, and other factory labor saving devices not possible in the field. The smaller type unit with remote water cooled condenser is generally the cheapest system available if all other factors are equal.

The use of factory assembled complete systems including evaporative condensers is generally the cheapest to install if extreme length of water piping is required or if the structure of the building is such that water piping would be expensive to install. This equipment gains wide favor by marketing and industrial firms having short term leases on facilities when conditions are favorable for their use. They offer the advantage of being readily moveable with only a minor amount of electrical wiring, water supply, and waste connections being required. They do require ductwork. The primary problem involved is to assure that the humid waste air is not recirculated.

Installation Cost

The third generality is that built-up systems using evaporative condensers are cheaper to install initially than similar systems using water cooled condensers if the capacity is one hundred tons or less. This is based on condenser water piping of average length, a fairly close-coupled evaporative condenser, with little or no ducting required for the evaporative condenser. On systems larger than one hundred tons, a water cooled condenser is generally cheaper.

A centrifugal compressor always requires a water cooled condenser.

On condensing systems that must operate throughout the winter, such as cold storage facilities, it is preferable to use an evaporative condenser. This permits them to be used dry. Modulating type dampers on the air intake will permit a constant head pressure to be maintained whether the unit is running dry or wet. Use of discharge air from a condenser operating dry will provide considerable supplementary heat at no cost. The author has seen an entire warehouse adjacent to a—10°F space heated in this manner. In this particular installation in Northern Florida, the original design had ducted the discharge through the roof. To assure the workers more comfort, a portion had been cut out of the duct, hinged, and permitted to block off the discharge thus deflecting the air into the space requiring heat. The space had been constructed without heat as the outside temperature rarely dropped below freezing, and that temperature for a short time would not damage the goods stored there. However, on average winter days, the heat from the equipment allowed the space to be approximately 15° warmer than the same space before the modification was made.

Comparative Operating Cost

Which cost less to operate? Assuming both are sized to operate at the same condensing temperature there should be no difference in total operating and maintenance cost if the condenser tubes and the tube bundle are maintained at the same degree of cleanness. This cleanness of heat transfer surface is the big bug-a-boo in the relative operating cost differences between cooling

tower and evaporative condenser.

A casual observation will indicate that a water cooled condenser will scale up faster than will an evaporative condenser. This is not actually the case despite this observation. The solids in identical water and condensing pressure will not drop out any faster in one type of cooling system than another under continuous operation. There is no known scientific principle that would indicate otherwise. Then what causes this misleading conclusion?

Maintenance Equal

These are caused by casual observation without any thought being given to the subject. It is agreed that a water cooled shell and tube condenser will lime up and create high head pressure considerably sooner than will an evaporative condenser. This is not caused by a faster rate of precipitation of minerals as under identical conditions, this fall out is the same.

This misleading conclusion is made by those who have neglected to consider the area of heat transfer surface. The area of heat transfer surface in an evaporative condenser is from five to six times as large as a water cooled condenser. This larger surface is required for two reasons. First, the water velocity is much slower than the velocity through the water cooled condenser. Secondly, the quantity of water circulated is considerably less.

These factors coupled with the fact that the same thickness of scale on the inside diameter of a ⅝ inch tube looks much thicker than it does on the outside of the same tube. These are the primary reasons why this conclusion is erroneously reached.

There exists but one logical conclusion. The apparent slow increase in scale build-up on evaporative condensers is the direct result of spreading the same weight of scale over a larger area.

One of the arguments put forth by personnel when they are made aware of the same weight of scale accumulation per hour of operation under identical conditions is that it would be preferable to use an evaporative condenser to cut down on the number of acidizations required as well as the total amount of acid. The number of acidizations required can be reduced but the quantity of acid saved, if any, is problematical.

It is true that it takes less acid to cut through 1/16 inch of scale than it would a 1/8 inch of scale but the total average thickness of scale for both cooling systems is the same under identical head pressures. Consequently, the amount of acid required is essentially the same. However, the coil in an evaporative condenser cannot be completely submerged in an acid solution in the same manner as a water cooled condenser. This requires either more or stronger acid or a greater length of time to remove the scale.

Cleaning Problem

The acidization of evaporative condensers presents problems that are not encountered in the conventional water cooled condenser. The problem of lack of total submergence has already been mentioned.

Another problem involved is that the scale forms on tube ends, on the bottom of tubes, and on portions of the sides of the casing where only occasional splatter of the water occurs. The locations are extremely hard to clean adequately.

Still another problem involved is that of adequate arrangement to circulate the acid. Almost all evaporative condensers are piped in such manner that it is difficult to connect a separate pump. Consequently, the serviceman usually dumps the acid into the system and uses the pump already on the system.

This is very detrimental to the pump unless the impeller and other components are of a material that does not react with the acid. Most pumps are not constructed to pump acid and as a result fail early when exposed to it.

Another problem involved is that most evaporative condensers have housings of galvanized steel or other finishes that are attacked to some extent by most acids. Acid should be used only where it is needed and should not be placed in contact with any surfaces unless a chemical reaction is desired.

Almost all refrigeration mechanics have had an opportunity to see at least one evaporative condenser that has scaled up prematurely because of an attempt to control head pressure by cycling the pump instead of the fan.

This heavy scaling was caused by water evaporating directly on the hot tubes on the off-cycle of the pump. Similar excessive scale accumulation, though to a lesser extent, occur on each cycle of the compressor on any evaporative condenser unless precaution is taken. One of the simplest precautions is to incorporate a time delay relay in the pump circuit that will permit the pump to run a short time after the compressor stops.

Shock Cleaning

Some mechanics advocate the use of evaporative condensers saying they are much easier to maintain and keep clean. Their usual method of removing scale is to shut down both the pump and fan motor and operate the compressor until a very high head pressure is obtained. Then they throw the switch to the pump starter to suddenly cool the coil.

The difference in linear coefficient of expansion between the metal tubes and the scale is such that with this sudden change in temperature causes the scale to break off. This method is not recommended as it could cause failure of the tube bundle and resultant loss of refrigerant.

This method of cleaning gives the best results on the top of the tube bundle where the temperature difference is the greatest. However, on lower interior portions, it is difficult to clear off all scale by this method.

Some scales are readily removable by acids, but others are resistant to all chemicals that would not adversely affect the condenser. These include scales of silica and sulfate compounds. They can be removed only by mechanical means. If these minerals are contained in the condensing water it is usually advisable to use a straight through cleanable type water cooled condenser. Thus, the scale can be readily removed with a brush or reamer.

Knowledge of these basic fundamentals should enable anyone to intelligently select the best water cooled condensing media for a specific application.

Keep a Safe Distance and Avoid Danger of Shock from "Live" Circuits

From Mutual Boiler and Machinery Insurance Co.

»» YOU don't need to touch an energized high-voltage conductor, insulated or uninsulated, to receive a fatal electric shock; the current can jump a considerable distance to ground through your body.

Obviously, there are many factors which govern the distance an arc will jump from a live uninsulated conductor to a person's body. Generally speaking, these factors can be listed in order of importance:

- Voltage level to ground
- Shape, size, and arrangement of electrodes
- Presence of other material in vicinity of arc gap
- Temperature, presure, and humidity of surrounding air

Arcing Distance

For a given voltage and common set of factors the arcing distance would be greatest between needle point electrodes, due to the high dielectric stress concentration at the points to cause ionization of the air, and least between sphere-shaped electrodes wherein the dielectric stress has a more even distribution. Handbooks usually give tables of spark-over distances in terms of crest voltage, size and shape of electrodes, and distance between electrodes. A modified table of spark distances for various r.m.s. sinusoidal voltages in air, at 25 C, 760 mm barometric pressure, and 80 percent relative humidity, for both the needle gap and sphere gap, are given in Table 1.

Table 1

Voltage r.m.s. sinusoidal in kv	Needle Spark Gap No. 00 Sewing needle points distance in inches	Sphere Spark Gap sphere dia. 62.5 m.m. distances in inches
10	0.47	0.157
15	0.725	0.26
20	1.0	0.346
25	1.3	0.441
30	1.63	0.543
35	2.01	0.65
40	2.44	0.764
45	2.95	0.885
50	3.55	1.03

Under prescribed conditions, spark distances are reasonably accurate. Hence spark gaps are used for measuring or limiting high voltages during overpotential testing. Theoretically, for a given voltage, the arcing distance between conductor and one's body would fall somewhere between the maximum value given in the needle gap column and minimum value shown in sphere gap column.

Safe Minimum Distances

To develop a safe minimum distance of approach to live circuits a very generous factor of safety is applied to the known arcing distance. The following are suggested as the minimum safe distances from unguarded live circuits:

Voltage		Safe Distance In Feet
751 to	3,500	1
3,501 to	10,000	2
10,001 to	50,000	3
50,001 to	100,000	5
100,001 to	250,000	10
250,001 to	500,000	15
500,001 to	1,000,000	25
1,000,001 to	1,500,000	35
1,500,001 to	2,000,000	45

Low Voltage Can Be Fatal

High voltage is by no means the major cause of fatal accidents. Statistics show that every year more than 700 persons are electrocuted in accidents involving voltages of less than 750 volts. Many of these fatalities are incurred from 110-volt lines. The factors which determine the severity of shock are the quantity, the path, and time of current-flow through the body.

The resistance to current flow through the human body varies widely from 100,000 ohms down to 1,000 ohms or less, depending mainly on contact resistance. A value of 500 ohms is the commonly accepted average value for the resistance of the body between major extremities. Although high voltage often produces severe destruction of body tissue at high resistance contact locations, the lethal effects of the electric shock are the result of the current actually flowing through the body. Hence the criteria of danger of loss of life from electric shock are based primarily upon magnitude and duration of current-flow through the body, or in other words, watt-seconds of energy.

Research on Animals

Experimentation has been carried on with animals at low voltage to develop the intensity of current-flow through a path in the body involving the chest, to produce a condition in the heart known as ventricular fibrillation, which is usually fatal. A theoretical criterion of danger for man has been developed from these experiments to predict the current and time duration to produce ventricular fibrillation in an average person. This theoretical data produced a straight line graph on log-log paper, with an upper limit of 400 milliamperes for .005 seconds and a lower limit of 75 millamperes at 5.0 seconds.

Electric shocks which cause respiratory inhibition, heart block and severe damage to the nervous system, and other mechanisms of death normally require currents of considerably greater magnitude than those which produce ventricular fibrillation.

Safety Rules

When working near electricity, always be careful to observe the following simple rules of safety:

- Observe the safe minimum distances as given above.
- Do not use metallic rules, flashlights or pencils.
- Do not wear finger rings, watch, chains or other objects having exposed conductive material.
- Treat all electrical conductors as being alive until found "dead" by actual test.

- Treat insulated conductors as bare conductors, since the insulation may be faulty.

Testing-Circuits

When testing a circuit to see if it is "dead" check all three phases since an intentional or unintentional grounded phase could be at zero potential to give a reading that is misleading. If no indication is shown on the tester for any phase, indicating the circuit is "dead" the operation of the tester should then be checked on the line side of the disconnect switch or on another circuit. In all instances the disconnect should be pulled, or the circuit breaker racked out, and tagged or locked in an open position before any attempt is made to conduct an insulation resistance or other test. You cannot be too careful in working around electricity because the first mistake can be fatal.

Whether a circuit is energized or "dead" should be checked independently by two or more persons. Preferably the plant electrician or his assistant should be responsible for deenergizing the circuit and making the necessary safety checks, followed by an independent check by another competent person before working on or testing the circuit.

Artificial Respiration

Electricity causes shock by paralyzing the nerve centers that control breathing or by stopping the regular beat of the heart. All who work with electrical apparatus would be prepared to save a life by being able to apply artificial respiration. The Holger-Nielsen Method, also known as the Back-Pressure Arm-Lift Method, has been adopted by the American Red Cross, the Bureau of Mines, Department of Defense, most public utility companies, and fire and police departments as the preferred method of applying artificial respiration. We also recommend the Back-Pressure Arm-Lift Method.

The Back-Pressure Arm-Lift Method not only gives the greatest exchange of air in the lungs but experimental work revealed the method could be taught more easily and performed with less exertion on the part of the operator. Obviously, however, when a victim has severely injured arms that cannot be raised, this method cannot be employed. One would then have to fall back on the Prone-Pressure Method or possibly the Silvester Method.

Every electrical worker should avail himself of the first aid training courses offered by such agencies as the Red Cross in gaining a working knowledge of artificial respiration. The life you save may be that of a relative or a fellow employee. Remember these points:

The victim must be freed from contact with the live conductor as promptly as possible. If the circuit cannot be immediately opened with safety, use a long dry stick or pole, or other non-conductor, to free the victim. Every second's delay in removing a person from contact with an electric current lessens the chance of resuscitating him.

If the victim is not breathing, or where breathing is very irregular and feeble, begin artificial respiration at once and send for a doctor.

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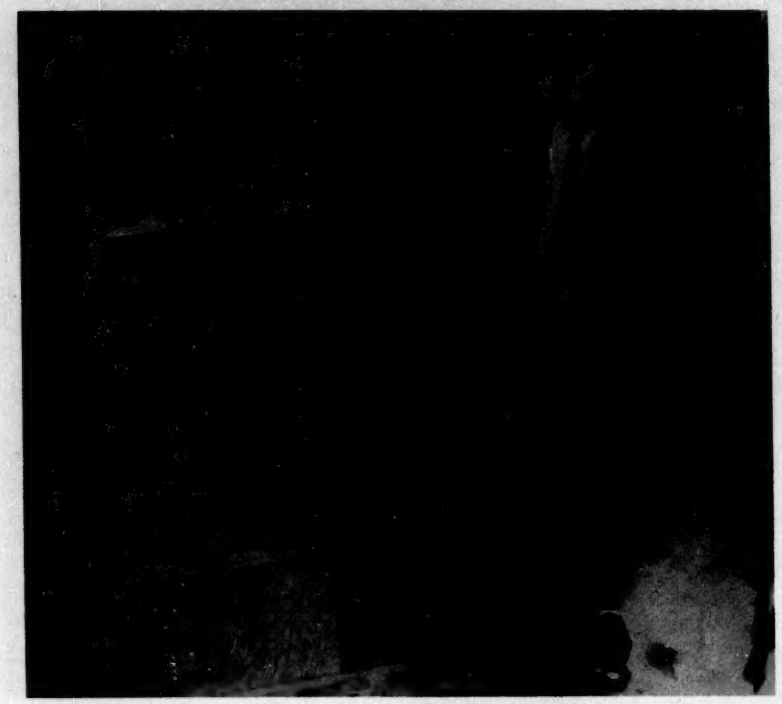


One of 200 three-foot ice cores, said to be 1,000 to 5,000 years old, taken this summer from an ice shelf near the North Pole, is checked upon its arrival at Dartmouth college's cold weather laboratory by Robert Blair, research assistant in the geology department. Flown to Greenland and then transported by ship to Bayonne, New Jersey, the crates of glacier ice were transported by a Thermo King unit-refrigerated truck for further study. The ice specimens are to be studied to understand the nature, origin, and future history of floating ice shelves, and to learn how to land aircraft on ice.

Preformed Rigid Urethane Foam
A Low Temperature Thermal Insulation

»» PREFORMED rigid, self-extinguishing, urethane closed cell foam is finding wide use as a low temperature insulation because of its superior insulating properties, its handling ease, and its ability to cut application costs.

Urethane foam, made by the Fibrous Products Division of Union Asbestos & Rubber Company, Bloomington, Illinois, is being used to insulate low temperature piping and equipment in homes, churches, commercial buildings, ships, and industrial plants.

R. L. Anderson, branch manager of Aber Company in Baton Rouge, La., says that workability is the biggest advantage of using urethane foam. "Because less thickness of the foam is needed for a job, workers can install it more quickly and efficiently. I find that it gives an average of about 20 per cent savings in labor costs and about 10 to 15 per cent savings in materials costs over other low temperature insulating materials," he declares. Aber Company has used more than 5,000 lineal feet of the preformed material in Esso's Baton Rouge refinery.

The foam's lightness and resultant handling ease rates high with Herbert Patten, sales representative with the Try-Bee Company, Saddlebrook, N. J. Try-Bee has used about 5,000 lineal feet for insulating brine lines at about 0° F. at Procter & Gamble's Port Ivory plant on Staten Island, N. Y.

UNARCO U-200 is a polyester urethane foam blown with Genetron fluorocarbon gas, which helps account for the foam's superior insulating properties—its K factor at 70°F. is 0.14, lowest of any preformed cold insulation material. Union Asbestos makes the foam from urethane prepolymers produced by John H. Witte & Sons' Resin Division, Burlington, Iowa. The basic ingredient in the prepolymers is isocyanates like those supplied by Allied Chemical's National Aniline Division.

The rigid foam comes in half-round sections, each section 36 inches long. The sections are available in nominal thicknesses and in standard pipe and tubing sizes. The product is also available in 12 x 36-inch block form—1 to 5-inch thickness in ½-inch increments.

Temperature limits are from -300° to plus 220°F. With a closed cell content of 85 per cent, the foam is essentially waterproof. Union Asbestos, however, recommends that a separate vapor barrier (usually a mastic) always be used for cold insulation purposes. The firm assures that its foam isn't affected by mastics or sealers normally used for cold insulation. And most solvents won't affect the rigid urethane foam either, claims the company.

H. C. Diehl To Get Man of The Year Award

»» DR. H. C. DIEHL, chairman of the Frozen Food All-Industry Coordinating Committee and a veteran of thirty-five years of service to the Refrigeration and Frozen Food Industry, will receive the coveted Man of the Year Award from the Delaware Valley Double "F" Club. Doctor Diehl will come here from his headquarters in Colorado Springs, Colorado, to attend the "Man of the Year" meeting at the Park Crest Restaurant in Camden on Monday, November 21st.

As chairman of the All-Industry Coordinating Committee, Dr. Diehl will meet again November 4th and 5th with AFDOUS leaders at Albany, California. His meeting with the Frozen Food Association of Delaware Valley is ideally timed to permit him to report on the progress being made in the Industry effort to create its own realistic, appropriate, and industrially practicable standards of

practice based on sound research.

The Frozen Food All-Industry Coordinating Committee in the selection of its chairman was directed by the various associations involved "to choose the best qualified man in the industry for this important project".

Dr. H. C. Diehl has been conspicuously identified with the frozen food industry since its inception.

In 1931 he directed the establishment of the U. S. frozen pack laboratory in Seattle. For many years he was in charge of food processing refrigeration for the USDA in the Pacific Northwest, and he was chief of the Commodity Process Division of the Western Research Laboratory at Albany, California. He has been a consultant to the Laboratory since 1951.

Headed TRRF

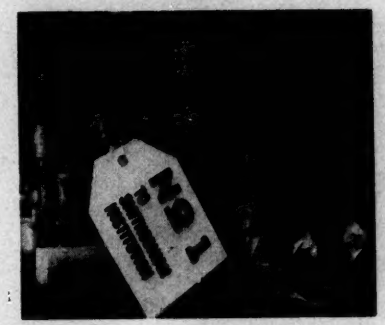
Between 1943 and 1958 Dr. Diehl established and headed The Refrigeration Research Foundation which achieved worldwide leadership in scientific research and encouraged the Time-Temperature-Tolerance investigations of USDA.

He is a member of many professional and scientific organizations, including AFDOUS, the American Association for the Advancement of Science, the American Society of Refrigerating Engineers, the Institute of Food Technologists, and the American Society for Horticultural Science. As a continuing member of the International Institute of Refrigeration he has been vice-chairman of the U. S. National Committee for the Institute.

Dr. Diehl is the author of more than one hundred USDA bulletins and many trade and professional articles. He was graduated from Michigan State University and did graduate work at Johns Hopkins University, the University of Maryland and Washington State College. He received an honorary Doctor of Science degree from the University of Rhode Island.

Dr. Diehl's latest service to the frozen food industry has been as vice-chairman of the All-Industry Task Force which was set up by these various associations as a clearing house for educational materials.

First Centrifugal



Historic compressor—Bearing an oversized shipping tag, the compressor of the first centrifugal refrigerating machine is hoisted from the loading dock at Carrier Corporation headquarters in Syracuse, N. Y. for shipment to the Smithsonian Institution in Washington, D. C. Developed by Dr. Willis H. Carrier in 1922, the compressor was recently retired after 38 years of service, and arrangements have been made for its inclusion in a new exhibit of air conditioning and refrigerating equipment to be unveiled by the Smithsonian next year.

Frozen Foods Committee Reports Rapid Progress

»» THE Frozen Foods All-Industry Committee activities are progressing with astonishing vigor and achievement, when one considers that the industry representatives, who are chairmen and members of action sub-committees, are all busy men with many other tasks and responsibilities, according to Dr. H. C. Diehl, chairman of the committee.

On October 7, the Sub-Committee on Education and Information members met in New York City, under the Co-Chairmanship of Dr. Milton Ratner, president of The Emery Transportation Co. of Chicago and Harry Schauffler, executive secretary of the National Frozen Food Association, Inc. of New York. Their deliberations resulted in concrete and immediate plans for educational motion pictures, regional training clinics, cooperation with the U. S. Extension Service in dispersal of educational information and in other actions designed to bring the useful information about proper handling of frozen foods to the attention of operating employees in all segments of the frozen foods industry.

The sub-committee on Voluntary Industry Operating Practices, under chairmanship of Richard Powell, executive vice president of the National Association of Refrigerated Warehouses of Washington, D. C. has completed its tentative draft of the integrated and voluntary industry practices and submitted them to the time-temperature tolerance specialists of the Western Regional Research Laboratory of the USDA for technical review, prior to further study and ultimate decision as to the adoption by several segments of the industry.

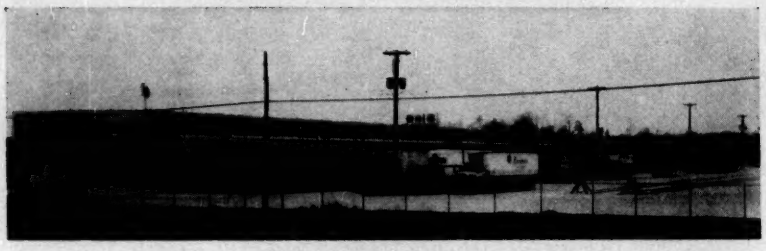
The program for the frozen foods time-temperature seminar, sponsored by the above USDA Laboratory on November 4 and 5 at Albany, California, by invitation, for committee members, for members of the executive and Frozen, Canned and Processed Foods Committees of AFDOUS has been completed. It is a profoundly comprehensive review program of the decade of research, upon which the voluntary operating practices of the committee are based, and should prove to be most informative and useful to all participating.

Committees Function

Many State committees of the FFAICC are now organized and have held their first meetings. These State committees will prove to be invaluable points of contact between government regulatory officials and industry and also serve as channels, through which educational and informative material can move to the grass roots of industry, where the action in the voluntary industry control program begins and from which it derives its vitality and sustained usage in the future.

"Possibly this is the first time in the history of the American food economy, that a major food industry has acted so promptly and comprehensively in concert, in all its related segments, to develop a voluntary quality control program from packer to retailer, in the interests of the American consumer" said Dr. Diehl recently, adding that the committee program was completely on schedule and achieving constructive results in all its facets.

State Farmers Market In Atlanta Has 125,000 Feet Refrigerated Space



Pictured is a portion of the $10 million State Farmers Market in Atlanta, Ga. in which 180 tons of refrigeration plays a vital role.

››› IN the $10 million dollar State Farmers Market at Atlanta, Georgia, one fourth of the 510,750 square feet of fruit and vegetable dealers' space is refrigerated. Two large restaurants are air conditioned and air handling units make working and shopping more comfortable for employee and consumer alike in food brokerage offices, barber shop, conference rooms and other public areas in the 146 acre facility.

The market, one of the world's largest, is ten miles out of Atlanta. It boasts 13,900 feet of rail trackage. Six of the buildings are served by a double railroad track and all of the nine concrete buildings have truck loading facilities.

The refrigeration facilities in the market were lauded by Bill Campbell, Georgia Commissioner of Agriculture, as "assets that will pay off in far easier and more efficient marketing of perishable agriculture products."

Approximately 180 tons of refrigeration are supplied by Recold ceiling coils and air-cooled and evaporative condensers. Twenty-five tons of this load utilize special ceiling mounted coils with reheat coils for a large banana room application.

Farmers' sheds in the sprawling mart were designed to provide produce with complete protection from the weather and thus preserve the quality of fresh fruits and vegetables before they enter the channels of trade. All told, eighty-one permanent tenants are in business in the market. A number of sheds were constructed for the use of temporary tenants as well.

Records show that during the heat of one summer, in the early pre-refrigeration days of marketing, the harried market operator placed ads in the paper to offer: ". . . at reasonable prices, sweet potatoes, black walnuts, and other farm produce."

The market had its beginnings as a small retail store in Atlanta soon after the close of the Civil War. From this little acorn, as the saying goes, grew the mighty oak of today.

Speakers From Industry to Address Plant Maintenance & Engineering Conference

››› SPEAKERS from a broad cross-section of industry will address the 1961 Plant Maintenance & Engineering Conference in Chicago next January. The conference is held annually during the first three days of the Plant Maintenance & Engineering Show.

The show is scheduled to run from January 23 through January 26 at the International Amphitheatre. Morning sessions of the conference will take place at the Amphitheatre and evening sessions at the Palmer House. Both show and conference are produced by Clapp & Poliak, Inc., New York exposition management firm.

Conference topics this year are balanced to include both the managerial and technical aspects of maintenance. Special "problem sessions" have been arranged for automotive, chemical, electronic equipment, textile, cement, metalworking and metal-fabricating, paper, petroleum processing, food processing, research and development and steel plants.

Management leaders from these industries are among the speakers along with others from such fields as telephone and telegraph, soap, aviation, business machines, tobacco, materials handling, pharmaceutical, rubber, instruments, rocketry, atomic energy, plastics, appliances and government.

Information about conference registration, instructions for sending advance "problems" to "problem sessions," rapid registration cards for the show and hotel information may be obtained by writing Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

T. R. R. F. Director Attends Fall Meetings Of All N.A.R.W. Chapters

››› DR. WALTER A. Maclinn director of The Refrigeration Research Foundation, attended the fall meetings of the seven chapters of the National Association of Refrigerated Warehouses. The meetings for the various Chapter areas were in Skytop, Pennsylvania; Mackinac Island, Michigan; Memphis, Tennessee; Fort Worth, Texas; Omaha, Nebraska; Monterey, California; and Seattle, Washington.

In almost every area there was an optimistic feeling that business was getting better. New business was being realized as a result of the research activities of The Foundation. New customers for the services of the public refrigerated warehouses were reported in every section of the country for the handling of candy and frozen bakery products particularly . . . items known to the warehouseman ten years ago.

Twenty-eight refrigerated warehouses, not now members of The Foundation, indicated their interest in becoming members. Fifteen pledged themselves to join, and the following companies have submitted their membership application forms with checks for their annual contribution:

Genesee Valley Cold Storage Co., Mount Morris, New York, John M. Sawyer, President.

K & R Refrigerated Warehouse, Hastings, Nebraska, George B. Rullman, President.

Mankato Cold Storage Company, Mankato, Minnesota, Morton J. Kaplan, Vice Pres.

Sedalia Ice & Cold Stg. Co., Sedalia, Missouri, Jack M. Cunningham, Pres.

Low Cost Defrost System

KRAMER Trenton Company, has developed and introduced the Thaw System, a companion to the Thermobank. It is a new automatic, hot gas defrost system for application where the primary factor is low first cost.

The Thaw System's more sophisticated design and construction offers considerably more than any system in its price range. The heart of the Thaw System is the metering accumulator designed to collect the liquid refrigerant during defrost and to slowly meter it into the suction line in small, tolerable amounts which can be completely re-evaporated.

The extra large liquid storage capacity of the Thaw System metering accumulator adds compressor protection. It has an easily removable strainer and metering tube, facilitating easy servicing should it be required. The gravity oil drain stops oil trapping in the accumulator and oil robbing of the compressor lubricating system. Control of liquid is positive by the use of a calibrated metering tube during defrost.

The holdback valve prevents compressor overloading during initial pulldown, defrost and at the start of the refrigeration cycle. Low temperature compressors can be used with standard electrical protection and it is not necessary to oversize the protection. (This is one of the major causes of compressor motor burn out.) The Thaw System produces more heat quickly for defrosting by maintaining a greater compression ratio and keeping the condensing temperature in the defrosting coils at a higher level.

Kramer's patented Ice-Coat Control eliminates unnecessary defrost cycles and prevents a defrost cycle from starting when the compressor is off. Frost on the product and box warm up is prevented by the post defrost period which keeps the evaporator fans off until the coil pressure is pulled down.

The evaporator has an all copper drain pan with copper heating coil which is soldered to the drain pan and protected by the outer aluminum casing.

The complete system includes metering accumulator, evaporator, heat exchanger, timer, hot gas solenoid valve, hold-back valve, hot gas strainer and check valve.

Temperature Control Bulletin

»» BULLETIN 109 gives a full description of indicating differential expansion type temperature control. This Model LD-1S is for electric operation and includes a snap-action Micro switch. Indication is with independent dial thermometer incorporated in tube assembly. Bulletin includes pictures, description of operation, and table of standard ranges, tube sizes, and performance. Bulletin 109 is available from Burling Instrument Company, Chatham, New Jersey.

Zurstadt Joins Detroit Controls Div.

»» HERBERT J. Zurstadt has joined the engineering department of the Detroit Controls Division of American Radiator & Standard Sanitary Corporation, Detroit, Michigan as a project engineer, according to an announcement by Richard L. Campbell, vice president-engineering.

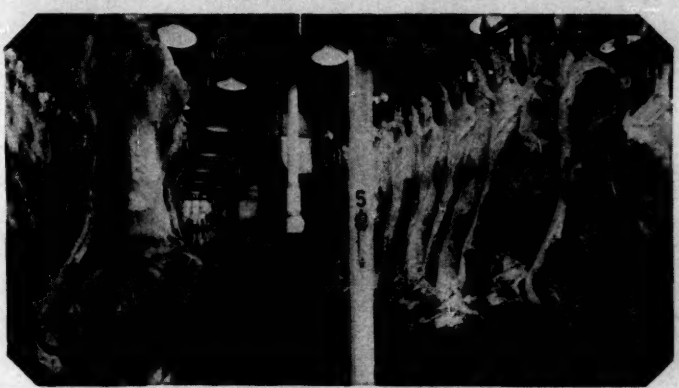
At his new post Mr. Zurstadt will supervise the division's combined refrigeration and air conditioning and commercial–industrial control project engineering teams, reporting to James A. Kozel, manager–product engineering.

Mr. Zurstadt, who has already assumed his new assignment, comes to the Detroit Controls Division of American-Standard from Ranco, Inc., Columbus, Ohio, where he has been a project engineer since 1958.

Previously, he held management, industrial, and design engineering positions for 12 years, first with International Harvester Company, Evansville, Indiana, and later at General Electric company, Morrison, Illinois.

A mechanical engineering graduate of the University of Cincinnati, Mr. Zurstadt is a registered mechanical engineer in the State of Indiana and a member of the American Society of Heating, Refrigeration and Air Conditioning Engineers.

NIAGARA "no frost"



FULLY AUTOMATIC REFRIGERATION

Fresh Beef Chilling

● Niagara No-Frost completely eliminates the frost problem of dry coils and the corrosion problem of brine systems. Now in fresh meat chill rooms as well as holding and shipping coolers, in provision holding and packaging and in all MEAT FREEZING Niagara No-Frost is giving users the lowest costs and best quality in the industry. Inspect the No-Frost plant nearest you.

Write for Bulletin No. 105

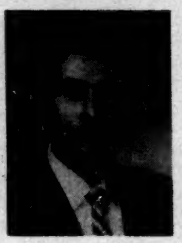
NIAGARA BLOWER COMPANY

Dept. IR-12, 405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities

Berthene Joins Recony Sales

»» VICTOR H. Berthene has joined the Recony Sales & Engineering Corporation of Richmond, Virginia, as assistant to president V. C. Patterson.



V. H. Berthene

In making the announcement, Patterson indicated that Berthene's appointment is the latest in a series of expansion steps taken by the 14-year-old company, manufacturers of cold-storage rooms, ice-cream hardening rooms, and pre-fabricated Reco-Fab modular ceiling and wall panels. The company's next expansion move, Patterson said, will probably be the addition of several associated lines to the company's product list, thus providing an even more diversified service to the frozen food industry. At present, Recony Sales provides a completely-integrated design, engineering, sales, construction, and service package to buyers of low temperature and other types of freezer rooms, and has served most of the giants in America's food industry.

Berthene, a native of New York City, was formerly the resident representative for York Corporation in the state of Virginia. He served four years in the U. S. Air Force and, after military service, earned a BSME degree at the University of Illinois. He joined York Corporation in 1956 and was employed in its Philadelphia sales office prior to his recent assignment in Virginia. Berthene is a member of ASHRAE.

In his new position, Berthene will assist V. C. Patterson in design, sales, and service on a national basis.

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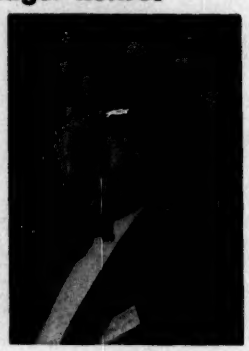
Quinn PFE Plant Manager Retires



Emmet T. Quinn

»» EMMET T. Quinn, plant manager, Los Angeles ice plant, Pacific Fruit Express, since July 16, 1947, retired August 31, 1960, after 39 years of service. Emmett has held various clerical and supervisory positions throughout the Southwestern District, starting as a yard clerk at Colton in 1921. Through his many activities in the PFE and with national refrigeration organizations, he has many friends in the railroad and refrigeration fields. He is a past national president of the National Association of Practical Refrigerating Engineers.

David R. Davidson has been appointed plant manager, Los Angeles, effective September 1, 1960. Dave started with PFE at Los Angeles in 1927 as an iceman. Prior to present appointment he was head repairman at Los Angeles ice plant.

William B. Clements Is Elected A Director Of Frick Company

»» THE election of William B. Clements to the board of directors of Frick Company, manufacturers of refrigeration, air conditioning, farm and forest machinery, has been announced by William H. Aubrey, president of the company.

Mr. Clements directs Frick Company's Pennsylvania-Bradford Appliance Division with headquarters in Philadelphia.

Before joining Frick Company, Mr. Clements was executive vice president of Seabrook Farms Company, Seabrook, N. J.

A graduate mechanical engineer, Mr. Clements taught engineering at the University of Delaware, for a time was a consulting engineer, and later served as president of his own firm, Clements Engineering Company.

In making the announcement, Mr. Aubrey said that Mr. Clements through his engineering knowledge and wide experience, will play an important role in Frick Company's current intensified expansion program.

A veteran of World War II with the rank of major, Mr. Clements lives with his wife and three children in Woodstown, N. J.

Little Named Centrifugal Consultant

»» PHILIP F. Little has been named consultant for special applications of centrifugal refrigeration machines for Carrier Corp.

P. F. Little

Mr. Little will have over-all responsibility for advising on non-standard uses of both open and hermetic type centrifugal chillers. Harland E. Rex will continue as centrifugal consultant for heat pumps, according to Richard S. Arnold, manager of Machinery and Systems application engineering.

Mr. Little formerly was supervisor of the refrigeration machinery section in application engineering. He has been with Carrier since his graduation from Stevens Institute of Technology in 1941.

Classified Advertising

All classified advertisements are payable in advance. Except for Positions and Help Wanted classifications, this section is reserved exclusively for USED equipment.

RATES: 20c per word; minimum 25 words. $2.00 per line for bold face headings: $15.00 per inch for line listings.

Position and Help Wanted

WANTED—Refrigeration installation and service mechanic, qualified on ammonia and "Freon" (Mostly ammonia). Must be capable of taking charge on larger installations; steady work and good pay for a qualified mechanic. Location Miami, Florida. Address Box DC-9, c/o Industrial Refrigeration.

USED EQUIPMENT—wanted & for sale

WANTED—One or possibly two 50-75 ton evaporative condensers; please give complete details in first letter, including make, age, condition, location, asking price f.o.b. truck; urgent. Write Box DC-8, c/o Industrial Refrigeration.

FOR SALE—Frick 10x10 compressor, 220/60/100 h.p. GE motor, priced $2200.00. For further details Address Box DC-5, c/o Industrial Refrigeration.

FOR SALE—York 7-1/2x7-1/2, 8x8, 9x9 with AC motors and starters; recently reconditioned, erected former Goebel Brewery, Muskegon, Mich.; will sell separatly at reasonable prices. Write for details. Jaco Equipment Corp., 3080 Main St., Buffalo 14, N. Y. Phone TF2-2100.

FOR SALE—Creamery Package 6-1/2x6-1/2, Creamery Package 5x3-1/2. Booster shell and tube condensor. York 8x8, 6-1/2x6-1/2, 5x5. Vilter 7-1/2x7-1/2. Frick 5x5. Niagara type evaporative condenser, 50 ton. Baltimore V, 53 ton. Two York air cooling units. Niagara brine spray cooler. Gordon Equipment Co., 6530 W. Jefferson Ave., Detroit 17, Mich.

FOR SALE—AMMONIA EQUIPMENT

2— 300 ton Niagara evaporative ammo. condensors.
1— 14x12" 4-cyl. Frick comp. D.C. to 600 h.p. motor, 327 r.p.m.
1— Worthington horiz. booster D.C. to 150 h.p. motor, 300 r.p.m.
2— 1 ton York ice making plants, 50# blocks, portable gasoline driven.
1— 10x10" 4-cyl. Frick duplex D.C. 225 h.p. motor.
3— 10x10" 4-cyl. York duplex D.C. 225 h.p. motor.
1— 9x9" 4-cyl. York duplex D.C. 150 h.p. motor.
3— 10x10" 2-cyl. York D.C. to 100 h.p. motor.
1— 9x9" 2-cyl. York D.C. to 75 h.p. motor.
2— 10x10" 2-cyl. York with V-type flywheel.
1— 9x9" 2-cyl. York with V-type flywheel.
2— 7-1/2"x7-1/2" & 8-1/2"x8-1/2" 2cyl. Vilters.
3x3", 4x4", 5x5" & 6x6" York & Frick comp.
3x3", 4x4" & 5x5" York Condensing units.
4— shell and tube condensers, 25 ton cap.
2— 300# Flynn & Emerick ice cubing machines.
2— 300# Gifford Wood ice cubing machines.

ENTERPRISE EQUIPMENT CORPORATION
328 Bryant Ave., Bronx 59, N. Y.
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Advise Us Your Needs
Use QUICKSEAL—stops brine tank leaks.
Use CLERTEMPICE—clears and tempers ice.
Born Company 80 East Jackson Boulevard.
Chicago 4, Illinois. WAbash 2-8290.

FOR SALE—Vilter 10-1/2x10-1/2 ammonia compressor, excellent condition, still hooked up; price $950. Address Box DC-7, c/o Industrial Refrigeration.

FOR SALE—Fuller model A150 ammonia rotary booster with Niagara model 685 and 660 No-Frost low temperature air units, complete with 6611 concentrator. Contact Hallam Engineering and Construction Corp., 80 Stanhope St., Brooklyn 21, N. Y., Hickory 3-5100.

FOR SALE—Ammonia equipment. One 8x8 York compressor with 25 h.p. motor; one 10' condensor; one 400 lb. ammonia tank. Milk Producers' Co-op, Inc. 6813-29th Ave., Kenosha, Wisc.

FOR SALE
2— 100 h.p. Carrier Brine chilling units.
1— 10x10 York direct connected 100 h.p.
1— 7-1/2x7-1/2 York 50 h.p.1-7x7 Frick 40 h.p.
2— 5x5 Yorks 15 h.p. each.
3— Niagara #633 "No-Frost" spray coolers, with concentrators.
1— Type 100 Flynn & Emrich ice cubing machine.

JOHN F. CARSON
A & Venango Sts., Philadelphia 34, Pa.
GArfield 6-2221

Miscellaneous

FOR SALE
PLAN AND SPECIFICATION
of our Automatic Oil Separator for ammonia refrigeration system. Increase the efficiency of your refrigeration up to 25 per cent; remove 99 per cent of the oil, not once, but continuously and automatically before it gets to the cooling coils; 24 hours per day. Saves trouble, labor and ammonia; tried, tested and approved for 5 years. Your engineer can build it for approximately $300.00. It is amazing; it is automatic. Plan and specification, $30.00.

FRANK W. PEARCE
525 Dixie Trail Raleigh, N. C.

QUICK RESULTS
with
Classified Ads

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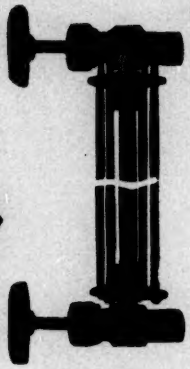

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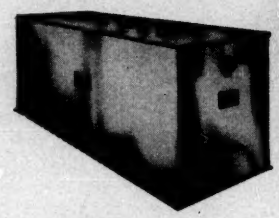

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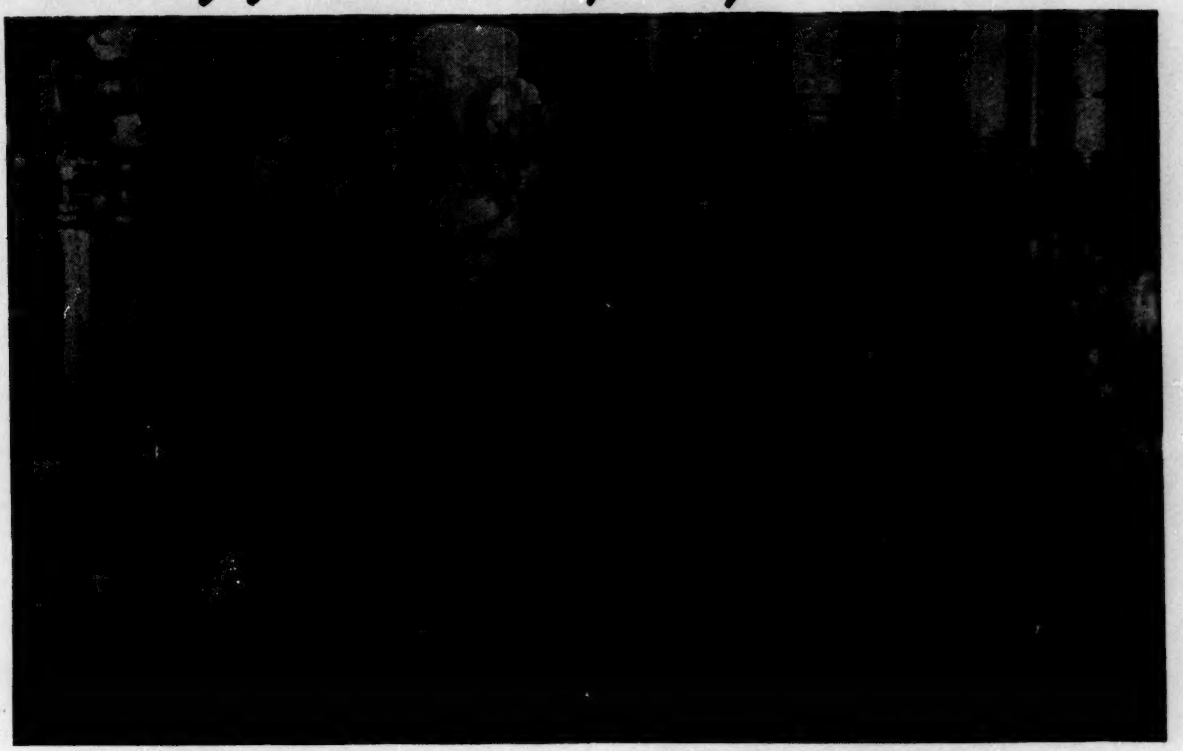

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